THE UNIVERSITY OF ALBERTA

RELEASE FORM

NAME OF AUTHOR: C.P. MacARTHUR

TITLE OF THESIS: SYSTEM INTERCONNECTION

CNCP TO TCTS MEMBER COMPANIES

DEGREE FOR WHICH THESIS WAS PRESENTED: M.B.A.

YEAR THIS DEGREE GRANTED: SPRING 1981

THE UNIVERSITY OF ALBERTA

SYSTEM INTERCONNECTION

CNCP TO TCTS MEMBER COMPANIES

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF BUSINESS ADMINISTRATION

DEPARTMENT OF BUSINESS ADMINISTRATION

AND COMMERCE

EDMONTON, ALBERTA

(SPRING), (1981)

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDENTS AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Rearch, for acceptance, a thesis entitled........................

..SYSTEM INTERCONNECTION - CNCP TO TCTS MEMBER COMPANIES..

submitted by..............C.P. MacARTHUR.................

in partial fulfilment of the requirements for the degree of Master of ....BUSINESS ADMINISTRATION...........

ABSTRACT

The objective of this thesis is to determine the advisability of allowing competition in the toll market segment of the telecommunications industry in Canada. Meaningful competition is achievable only when the consumer has access to the vendor's facilities via the local switched network of the franchised common carrier. This type of access, referred to as system interconnection, had been illegal in Canada until May 17, 1979 when the CRTC handed down its decision on CNCP's application for system interconnection with Bell Canada.

Through analysis of the operating environment and in particular the relationship between the common carriers, the regulators and the appropriate level of government, we have shown how the industry developed and its current mode of operation. Of primary importance is the identification of the market segments, the level of investment and relative cost of serving these markets and the revenues generated within these segments.

Review of the economic literature dealing with competition in regulated public utilities and monitoring of the ongoing evolution of the industry in the United States provided the required information to reach a conclusion.

The conclusion consisted of rejection of the CRTC's decision on the basis that fragmented decisions made without the benefit of clear industry-wide objectives would prove to be dysfunctional in the long run. Alternative and supportive recommendations are provided after substantiation of the conclusion.

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CHAPTER I

SCOPE

On June 14, 1976, Canadian Pacific Limited (CP) made application on behalf of its communication division, Canadian Pacific Telecommunications (CPT), to the Canadian Radio-Television and Telephone Commission (CRTC) for a ruling which would force Bell Canada to provide for the interconnection of Canadian Pacific telecommunication facilities to the local switched network of Bell Canada. On July 2, 1976 Bell Canada filed an application for a CRTC order requesting further information from Canadian Pacific Limited and a suspension of proceedings until the information was made available. Following subsequent correspondence between the CRTC, Bell Canada and Canadian Pacific, and prompted in part by letters from intervenors lining up behind the protaganists in this confrontation, the CRTC, by the issuance of Public Notice 1977-12 on August 2, 1977, announced that it would hold a public hearing. This thesis is a study of that portion of the Canadian communications industry and its operating environment identified by the CRTC hearing.

By means of analysis of the economic and policy issues raised in this hearing, we will, through assessment of the impact on the main participants and others affected by the implementation of the decision set down by the CRTC on May 17, 1979, accept, reject or recommend an alternative to this decision. The decision ordered Bell Canada to provide the necessary facilities to connect the communication system of Canadian Pacific Limited to the local switched network of Bell Canada.

Canadian Pacific Limited was to compensate Bell Canada according to the fee schedule set down in the decision.

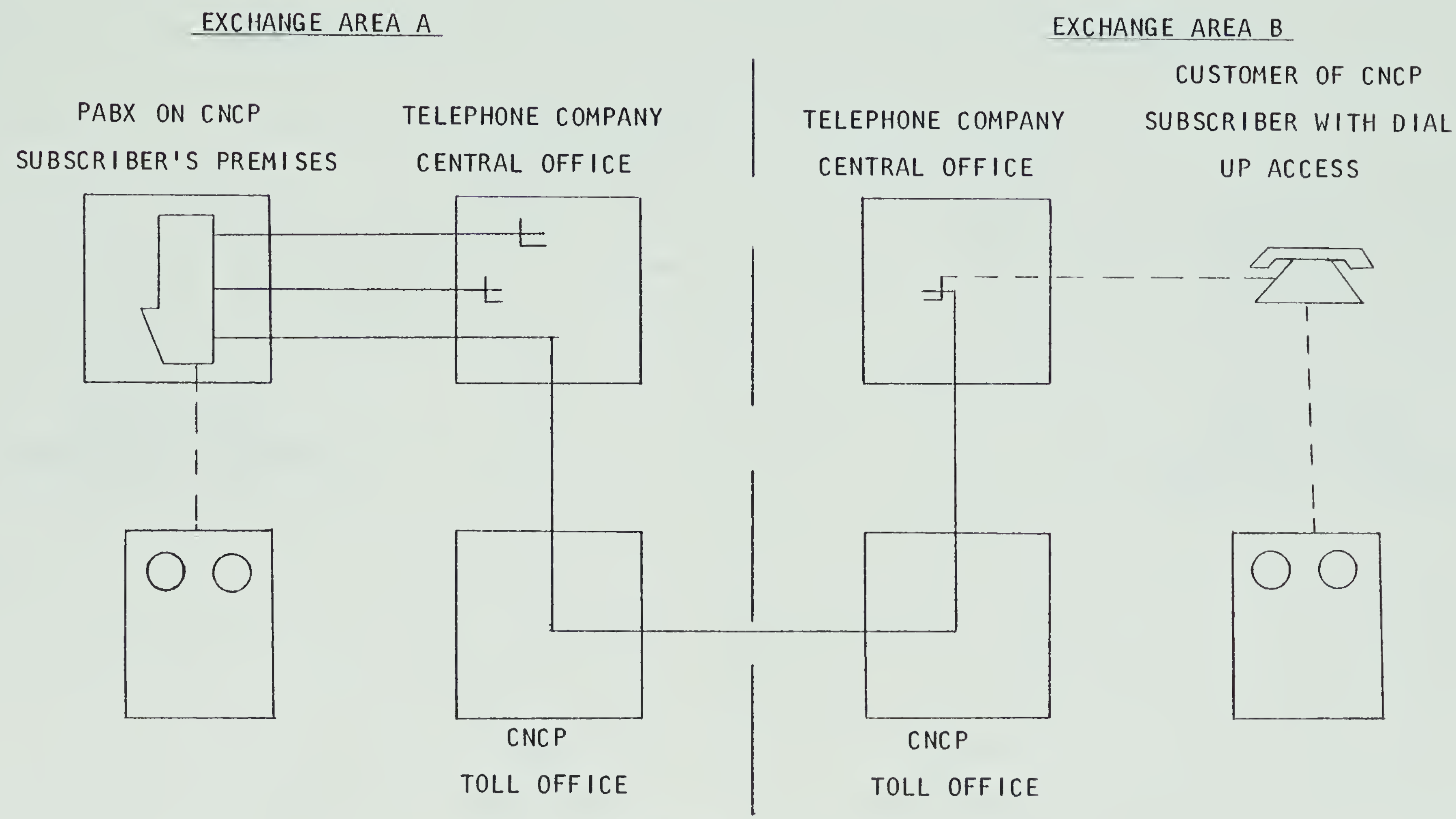
The interconnection ordered by the CRTC is quite specific and is detailed on pages 261 to 268 of the CRTC, May 1979, Decision. In general terms, it directs Bell Canada to provide two basic types of interconnection.

> Type 1: Bell shall provide switched terminations of loops from the Canadian Pacific switching offices which provide for access to the switching and transmission facilities of CPT by customer connected to the local switched network of Bell Canada. This type of connection allows for dial-up access to most services provided by CNCP, by anyone with access to the local switched network. A diagram of a typical Type 1 interconnection is Figure 1 on page 3.

> Type 2: Bell Canada shall allow termination of loops, connected to CPT switching and transmission facilities, on Bell Canada switchboards, located on the customer's premises, with access to local switched network. This connection would allow for calls coming into the switchboard from the network to be extended to the CNCP network or the off-ending of calls, coming into the switchboard from the CNCP network, the local switched network. A diagram of a typical Type 2 interconnection is Figure 2 on page 4.

Unless reference to either type of interconnection is required, they will be referred to in general as system interconnections throughout this thesis.

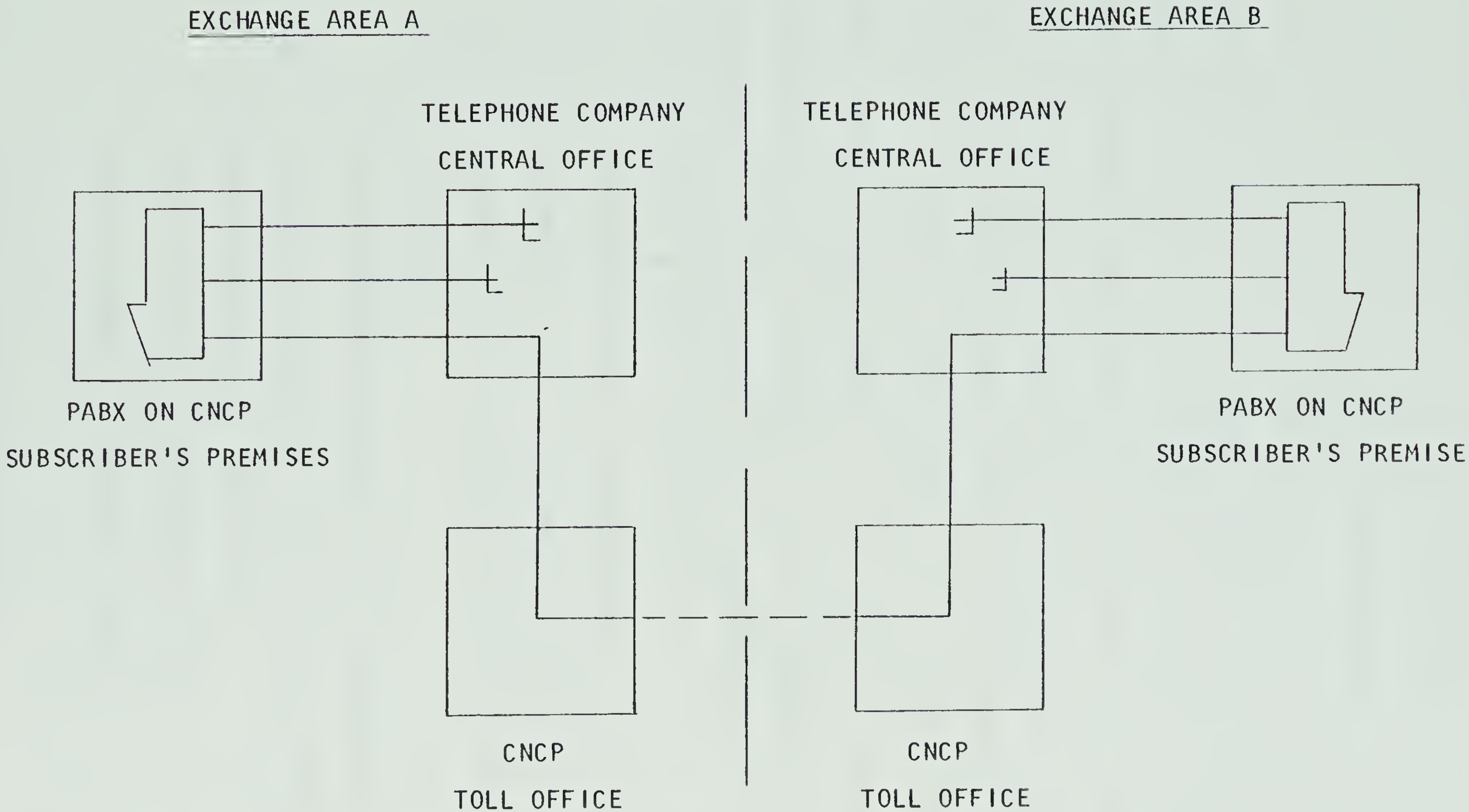
FIGURE 1



TYPICAL TYPE 1
INTERCONNECTION

SOURCE: BELL CANADA EVIDENCE IN CHIEF.

FIGURE 2



TYPICAL TYPE 2
INTERCONNECTION
(WITH OFF-ENDING CAPABILITIES)

SOURCE: BELL CANADA EVIDENCE IN CHIEF.

As the hearings progressed the number of participants grew, forming six distinct but inter-related groups.

The first group consists of the communication divisions of Canadian Pacific Limited and Canadian National Railways (CNT) which are involved in a consortium referred to as CNCP Telecommunications. This consortium, though not a legal entity, virtually replaced Canadian Pacific Limited as the "Applicant" in the interconnection proceedings in that the CRTC requested that CN be included in the application and subsequently most of their submissions were made under the name of CNCP. CNCP operates a nation wide communications network based on a system of agreements between the parent companies, which sets down the terms and conditions under which CNCP shall allocate expenses and revenues incurred in the normal course of business, to the parent companies. In the communications industry CNCP falls under the classification of a specialized carrier.

Bell Canada forms the second group. Bell Canada is the franchised common carrier in Quebec and Ontario and consequently is the largest telephone company in Canada serving 62.4 percent of the telephones in Canada.

The third group consists of the common carriers who, with Bell Canada, form the Trans Canada Telephone System (TCTS). The members of the TCTS consortium area are as follows:

Alberta Government Telephones (AGT)

British Columbia Telephones (BC Tel)

Bell Canada

Manitoba Telephone System (MTS)

Maritime Telephone and Telegraph (MT & T)

New Brunswick Telephone Company (NB Tel)

Newfoundland Telephone Company

Prince Edward Island Telephone Company (Island Tel)

Saskatchewan Telecommunications (Sask Tel)

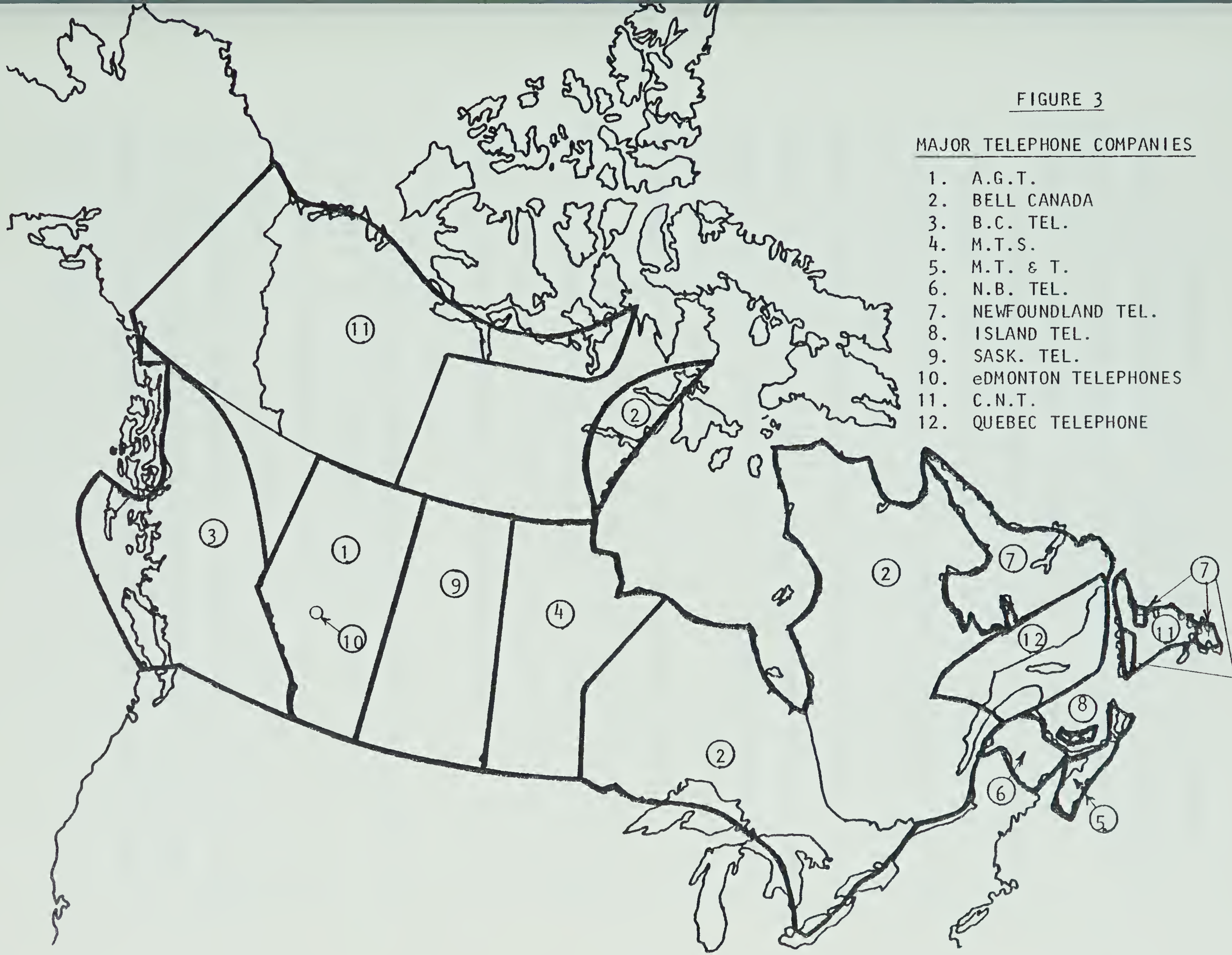
Telesat Canada

With the exception of Telesat Canada this group of common carriers operates both local and toll facilities within their franchised operating area. The remaining members of the TCTS consortium, excluding MT & T which serves Nova Scotia, and Bell Canada which serves Quebec and Ontario, provide telecommunications within the provinces after which they are named.

Bell Canada, BC Tel and Telesat are the only members of TCTS with federal charters and as a result are regulated by the CRTC. The remaining members have provincial charters and are thus subject to provincial regulation. See Figure 3 on the following page, for the geographic distribution of common carriers in Canada.

The fourth and fifth groups, which we have identified as participants in this confrontation, have a degree of commonality in that they are both consumers of telecommunication services, but the effect of the decision made by the CRTC will be significantly different for each group. The fourth group which we identify as the business customers see the resultant competition as having a positive impact on their communications cost, and intervened, although not extensively, on behalf of CNCP. Due to the nature and scope of their communication needs it will be shown that the larger businesses stood to gain the most from the system interconnection of CNCP.

FIGURE 3



MAJOR TELEPHONE COMPANIES

1. A.G.T.
2. BELL CANADA
3. B.C. TEL.
4. M.T.S.
5. M.T. & T.
6. N.B. TEL.
7. NEWFOUNDLAND TEL.
8. ISLAND TEL.
9. SASK. TEL.
10. eDMONTON TELEPHONES
11. C.N.T.
12. QUEBEC TELEPHONE

The residential customers formed the fifth group directly affected by the CRTC decision. They were not directly represented at the hearing but the hypothetical effects on them were used by both protangonists in an attempt to strengthen their arguments.

Government, both federal and provincial, could be considered as a sixth group. The primary concern of this group, other than the regulation of the carriers under their respective jurisdictions, appears to be the development of the most propitious position from which to continue the debate on jurisdiction in communication matters. This concern is just another aspect of the ongoing federal-provincial power struggle but could be very instrumental in shaping the communications environment and in determining the extent to which the CRTC decision is implemented outside of Ontario, Quebec and British Columbia.

The special interests of these groups dictate the reasons for their involvement and the extent of their participation. By detailing these interests and investigating the rationales behind their actions, we will attempt to more clearly define the problem which in turn will facilitate further analysis.

The CNCP consortium was the result of CNT and CPT recognizing the economies of scale and better coverage available through cooperation. This applied to the efficiencies to be gained in the day to day operation and in particular to the development and construction of a Trans-Canada microwave facility. Without this facility they could never compete effectively with the TCTS consortium, nor could either company justify the capital or operating costs for the establishment of their own system.

As in the case of most railway companies in Canada, the communication links required to run the railroad were provided by the railroad companies. Open wire lines along the rail right-of-way provided this service, with spare capacity being used to provide telegraph service for anyone wishing to pay the tariff. CNT and CPT went further than most other railways in that as technology and the need progressed, they moved into the provisioning of private line services. Private line services are rented on a full time basis with charges based on mileage, loop conditioning required, cost of terminal connections and the cost of the local loop, which for CNCP services is normally leased from the franchised common carrier(s) serving the areas of origin and termination.

In 1956, CNCP expanded the teletype from a private line to a switched service which they call Telex and subsequently progressed, as a result of advances in technology and demand for expanded services, into data transmission, which required the establishment of dedicated switched networks to provide the various data services. The data services are primarily segmented by speeds and the degree of interaction between terminals, switch, and host computer. No matter how sophisticated the CNCP service offering may be, the final link between the customer and the CNCP network, prior to implementation of the CRTC decision, has been provided by the common carrier on the basis of a dedicated loop from the CNCP office to the customer's premises. See Tables 1 and 2 on the following pages for a brief description of the CNCP services with a cross reference to the equivalent TCTS offering.

TCTS and its member companies provide a similar range of services on both a private line and universal access basis. The

TABLE 1 - SERVICE DESCRIPTION SUMMARY

TERMINAL SERVICE	MAJOR CARRIER	SERVICE DESCRIPTION	SPEED
Datacom 100	TCTS	Teletypewriter using DDD Network	110 Baud
Datacom 300	TCTS	Teletypewriter using DDD Network	300 Baud
Datacom 400	TCTS	Teletypewriter using DDD Network	300 Baud
Datacom 600	TCTS	Buffered teleprinter	1200 bps
Datacom 1200	TCTS	Teletypewriter using DDD Network	1200 Baud
Teletypewriter	All Carriers	Teletypewriters	45 Baud - 150 Baud Variable
VUcom 1	TCTS	CRT, Printer, Tape, Cassette	75 Baud - 9600 Baud
VUcom 2	TCTS	Programmable, CRT, Tape Cassette, Printer	1200 - 9800 bps
VUcom 3	TCTS	CRT, Printer, Tape Cassette	110 Baud - 9600 Baud
VUcom 4	TCTS	CRT, Printer, Tape Cassette	110 Baud - 9600 Baud
Datasets	All Carriers	Modems	Full Range
Infomode 50	CNCP	Quiet, compact RO printer	49.5 - 255 Baud
Infomode 80	CNCP	Quiet, compact RO printer	110, 150,300 Baud
Infomode 150	CNCP	Up to 165 cps print speed, serial impact printer with compressed print	110 - 600 Baud
Infomode 101	CNCP	Micro-processor controlled teleprinter for Infoswitch applications	110, 150, 300 Baud
Infomode 200R	CNCP	Intelligent CRT, up to 32K RAM and 8K EPROM	Up to 9600 bd. asynch.
Infomode 800	CNCP	Intelligent CRT, printer, diskette, disk	Up to 38,400 b/s asynch.
Infocourier 100	CNCP	Sub-minute facsimile	Up to 56,000 b/s 9600 Baud

Source: These tables are adaptions of tables contained in the recently released (February 1980) Data Market Survey by Canadian Telecommunications Carriers Association, titled Data Telecommunications Services and Networks in Canada.

TABLE 2 - NETWORKS

SERVICE	SWITCHED OR NON-SWITCHED	SPEED RANGE: SUB-VOICE (300) BAUD	VOICE (300 - 9600) BITS PER SECOND	ABOVE VOICE (9600) BITS PER SECOND	MAJOR CARRIER
Direct Distance Dialing Network (DDD)	Cct Switched	1	up to 1200 async up to 2400 sync		TCTS
Telex	Cct Switched	50 Baud			CNCP
TWX	Cct Switched	up to 110 Baud			TCTS
Data Telex	Cct Switched	up to 180 Baud			CNCP
Multicom 1	Cct Switched		up to 1200 async up to 2400 sync.		TCTS
Broadband Exchange Service	Cct Switched		up to 9600 BPS	up to 48KBPS	CNCP
Multicom 2	Cct Switched		up to 4.8 KBPS		TCTS
Multicom 3	Cct Switched			up to 50KBPS	TCTS
Telenet	Message Switched	1	1	1	CNCP
Infodat	Non-Switched Digital	1	1	up to 56KBPS	CNCP
Dataroute	Non-Switched Digital	1	1	up to 56 KBPS	TCTS
Datapac	Packet Switched	1	1		TCTS
Infoswitch	CCt Switched, Virtual Connection, Packet Switched	1	1	1	CNCP
Alta-Net	Not-switched		up to 2400 sync.		A.G.T.
Computer Message Switching Service (CMSS)	Message Switched	1	1	1	CNCP

'a full range of speeds available

Source: These tables are adaptions of tables contained in the recently released (February 1980) Data Market Survey by Canadian Telecommunications Carriers Association, titled Data Telecommunications Services and Networks in Canada.

flexibility available to a customer of the common carriers is further enhanced by the fact that his terminal equipment may be used in either private line or universal access mode. The terminal devices supplied by CNCP may not be connected to the switched network ⟨1⟩ in any way.

CNCP contended that the shift in emphasis from information transfer to interactive type services and terminals will severely limit their growth in spite of their innovativeness in product development, because of the lack of flexible access by customers of firms originating or terminating services, using CNCP transmission facilities. In their application CNCP contended that their financial viability is threatened and that the consumers of these services are being deprived of the innovative product development, price flexibility and choice of supplier, normally associated with a competitive market. The application further postulated that there would be no loss in revenue to Bell Canada due to the overall market stimulation resulting from increased advertising and marketing activities necessitated through operations in a competitive environment.

Bell Canada's response was primarily centered on the anticipated loss of revenue from one of the more lucrative segments of their total market, business derived toll services. They based the bulk of their arguments on the adverse effect that this loss of revenue, in a highly profitable area, would have on the provision and/or cost of basic service to the residential customer. They expressed further concern over the integrity of the network, difficulty in identifying

⟨1⟩ Switched network refers to the world wide network of communication facilities formed by the interconnection of common carriers networks on an international basis.

responsibility for failures with the absence of end to end responsibility and lack of control over calling patterns or utilization of the switched network. While the CRTC decision was primarily intended for data communications it was recognized that voice supervision or even direct voice communications would be difficult to control on the types of connection permitted. Bell expressed further concern about the problems involved in detecting when a customer was by-passing the normal toll network by off-ending through a switchboard terminated trunk to the local switched network, thus completing what would have been a normal toll call without the use of Bell's toll facilities.

The remaining members of TCTS who intervened on an individual basis offered arguments similar to those of Bell Canada but with slightly different emphasis. The shift in emphasis was a result of being regulated by provincial agencies, with the exception of BC Tel, and variations in the sources of revenue. As a result of having to serve the more sparsely populated and remote areas without having the large urban areas with a high level of business activities from which to generate revenues, the majority of the other TCTS members derive a larger percentage of their revenues from toll operations. In 1978 Bell derived 46 percent of their revenues from toll whereas the toll portion of the revenues for the remaining members ranged from 55 percent for MT & T to a high of 66 percent for Sask Tel. Therefore these companies, and primarily the prairie telephone companies, felt much more vulnerable or susceptible to the effects of competition in the toll services area.

Members of the fourth group, which we have identified as business customers, have, because of their variety of interests, the most diverse concerns of any of the groups. The diversity is primarily

a function of size and services offered. If the company is national or international in scope, intra-company communications form an important aspect of its total communications requirement. Car manufacturers with their network of dealers across the country, or similar forms of manufacturer controlled distributors, may best be served by a private line network. Private line networks would provide for efficiencies in both costs and usage.

Banks or near banks could operate on a private line or high speed switched data network for their normal banking operations, but would require more flexible and universal access for credit verification associated with their charge cards.

Computer service companies could operate more efficiently with universal access for their smaller customers and with dedicated or switched high speed facilities for their larger customers. Some of the smaller customers may reduce their computer costs with batch rather than on line, real time processes.

More detailed analysis of the communication market will be made in Chapter VII, suffice to say that for problem definition, the communication requirements for business operations range from large volume with narrow and wide spectrum to small volume with narrow spectrum. In number, the highest percentage of businesses require nothing more than plain ordinary telephone service (POTS), but the larger businesses, 20 percent of the total, generate 70 percent of the toll revenue derived from business customers, and require the more complex and sophisticated systems. It is this revenue which is most susceptible to the competition which will result from the implementation of the CRTC decision and to which the TCTS carriers are most vulnerable.

The residential customer has, until recent times, demanded nothing more than POTS. This has enabled him to access or be accessed from the local network with a high degree of reliability at a reasonable rate. This low rate is the result of the cross-subsidization he receives from toll and business services. The fact that technology has developed a broad range of new, more sophisticated services which are currently in the field trial stage will not greatly affect the need for POTS and the requirement to maintain a relatively low price for this service. This was the only interest group, as we have identified them, which did not become actively involved in the hearings.

The last group which we identified are the governments, both provincial and federal. The federal government was involved directly through the CRTC and probably influenced the decision adversely, from Bell Canada's point of view, when the federal cabinet over-turned a previous ruling by the CRTC on the admission of Telesat Canada to the Trans Canada Telephone System. On this occasion however, after an appeal to the Federal cabinet by Bell Canada, it upheld the CRTC decision.

The provincial governments of Ontario and Quebec intervened directly, while the governments of the prairie provinces were indirectly involved through the actions of the telephone companies they operate within their respective borders. It appeared that the provincial governments had decided that little could be gained in their battle for control of communications through confrontation with the federal government on this issue. This federal-provincial conflict will be more thoroughly investigated in chapter IV which deals with regulation.

Having identified the main protagonists and the reasons for their involvement (the remaining participants and their particular interests in the CRTC's decision), we can proceed to analyze the Canadian communication industry with the intent of evaluating the CRTC decision. The analysis, though centering on and drawing from the evidence submitted during this hearing, will be expanded to permit consideration of the total Canadian communications industry. We shall consider the perspective of all interested groups which we have identified.

CHAPTER II

COMMUNICATIONS IN CANADA

Brief History

The need to review, albeit very briefly, the history of telecommunications in Canada, is to demonstrate or reinforce the following points.

1. Large scale development cannot take place without the availability of state of the art communication facilities. This frequently neccessitates investment by the franchised carriers in remote areas with reduced probability of payback. This type of investment is required by the regulator, with the resulting services provided at the standard tariff rates.
2. Vested interests are significant factors when contemplating changes to the status quo. This is particularly true when the interests were acquired through guidance or direct action by the regulator. When you consider the size of investment required to participate even on a small scale in telecommunications, the argument of a changing operating environment is of little significance when compared to eliminating the effectiveness of large investment.
3. TCTS, which is a consortium of common carriers that operate significant toll networks, was the product of necessity and common sense. TCTS is of vital importance to telecommunications in Canada through its coordination

> of operating and technical standards, the provisioning process and the administration and allocation of toll traffic and the resultant revenues. Its existence is rather tenuous and is dependent on compromise among its members in that the allocation of toll revenues is a zero sum proposition; what one company gains another must give up. The existing systems of accounts used by the member companies do not allow for the objective allocation of revenue in proportion to identifiable costs incurred in providing the service.

By 1910, the structure of the telephone system in Canada was very much as it is today. The impetus for the spread of telephone communication in Canada was generated by the Bell Telephone Company of Canada which was 25 percent owned by the National Bell Telephone Company of Boston. Bell Canada was the result of consolidation of the major telephone and telegraph companies in Central Canada in 1880 by Charles Sise, a retired sea captain appointed by the American parent to run the Canadian operation.

Bell Canada initiated the major development of telephone systems both east and west. This was done primarily through the appointment of agents and, when capital ran short, the leasing or sale of the right to use Bell equipment.

In 1888, the Nova Scotia Telephone Company was formed under the control of Bell Canada. In 1910, the name was changed to Maritime Telephone and Telegraph and the following year it purchased 67.5 percent of the shares of the Telephone Company of Prince Edward Island, a

company which was incorporated in 1888 but found itself in financial difficulties. This firm is now known as Island Telephones.

The New Brunswick Telephone Company, commonly referred to as New Brunswick Tel, was incorporated in 1889. Bell Canada at that time held the controlling interest in New Brunswick Tel and today owns most of the outstanding shares.

The Anglo American Company was the first significant provider of telephone services in Newfoundland. The Avalon Telephone Company Limited, which changed its name to Newfoundland Telephone Company in 1970, was incorporated in 1919 and was the firm which consolidated most of the major telephone holdings on the island. Canadian National Telegraph serves 70 percent of the land area, but only 35 percent of the phones and interconnects to the remainder of the country through facilities of Newfoundland Tel. Newfoundland Tel also serves Labrador, which was not included in the calculation of the 70 percent land figure.

The development story in the west was initially very similar to what occurred in the east. Sise, consistent with his dream of a Canada-wide telephone system, attempted through the use of agents and paid employees to establish Bell as the telephone company in most of the major centers. He was having some success, but was confronted with problems in finding dedicated managers, realizing profits, providing service in the sparsely settled areas, managing the desired growth from such a great distance and fighting the westerners' inherent distrust of large eastern firms.

Politicians spurred on by complaints of poor or no service, especially from the rural population, fell back on the use of Crown Corporations. Manitoba bought out the Bell holdings in that province on

January 15, 1908 and created the Manitoba Telephone System. Alberta followed suit on April 1, 1908 and created the Alberta Government Telephones. In 1909 the Saskatchewan Government bought out Bell interests and established Saskatchewan Government Telephones as part of the Department of Railways, Telegraphs and Telephones.

Consistent with the development of other industries on the western side of the mountains, British Columbia's commercial communications ran north-south. B.C. Telephones was initially a Canadian firm, formed by the amalgamation of local telephone companies in the interior of British Columbia in 1904. It ran into difficulties in financing the provisioning of services up the rugged west coast in 1927, and sold out to American interests. Today, though it is still called B.C. Tel, it is controlled by General Telephones Ltd. of the U.S., and is the only major Canadian telephone company under the control of a U.S. parent company.

By 1910, but for a few name changes, the operating companies and boundaries of their franchises were established along today's format. Equipment in use at that time was primitive by current standards, but the telephone companies did manage to provide a valuable service and the impetus for Canadians to become the most foremost telephone users in the world, a title they gained in 1921 and have yet to surrender.

In the United States, as in Canada, the general configuration of the telephone industry was established early. Long Lines, an operating group of American Telephone and Telegraph (AT & T), was established in 1890 as an operating division of the America Bell Telephone Company. Long Lines was assigned the task of providing

interstate long distance service. In Canada, any inter-provincial traffic was carried across borders on the basis of interconnecting agreements between the connecting carriers.

The establishment of a cross-Canada network was impeded by the natural boundaries, which have always obstructed the development of most forms of transportation and communication networks, and which serve to divide Canada into its four distinct regions, Maritime (east coast), Central Canada, the Prairies and the West coast. Rather than attempt to cross these boundaries with communication facilities, it was more practical to route the calls south to the United States, east-west on the facilities of Bell Long Lines, and north to the terminating province. The first call from Montreal to Vancouver was made in 1916 and the first Ottawa to Vancouver call was made in 1920. These calls, as were most east-west calls of similar distance, were routed through the United States.

The first step towards the establishment of a Trans-Canada network was an attempt to form a prairie province telephone system in 1920. The discussions escalated to the formation of a Canadian network, and the Telephone Association of Canada was formed in 1921. The impetus for the development of a Trans-Canada facility was both nationalistic and economic. Even at that stage in the development of the telephone industry, it was recognized that toll service was most beneficial and that use of Long Lines' facilities meant that a good portion of the revenues from such calls were being lost to the United States.

The nationalistic side of driving force was given further impetus with the first Trans-Canada radio broadcast in 1927, produced as part of the celebration of the Diamond Jubilee of Confederation.

Though the plan for a Trans-Canada network had not yet been finalized, the desire to avoid the use of Long Lines' facilities prompted adjacent carriers to interconnect directly in order to interchange inter-provincial traffic.

In 1931 the Telephone Association of Canada gave way to the Trans Canada Telephone Association. A formal agreement, containing the basic concepts and rules of operation for TCTS was signed on August 4 of that year and it was agreed to proceed with the upgrading and building of the required facilities in each jurisdiction so that they might be interconnected to form a Trans-Canada network.

The facility was officially commissioned into service in January 1932. This was the beginning of TCTS as a major force in telecommunications in Canada.

Even though portions of the Trans-Canada facility had to be equipped with 'C' carriers, ⟨1⟩ in order to overcome the problems associated with having to transmit a voice signal over long distances, it was the switching systems which were setting the pace with respect to technological advances. The automatic switching office using Strowger SXS switches was introduced in 1909 and the cross bar, common control office, which represented a major advancement, was introduced in 1950. The first major improvement over the open wire carrier was the introduction of the TCTS microwave system in 1957.

This was the first coast to coast microwave system and many problems in financing and engineering had to be overcome. Since no one had experience with systems this size, coupled with the fact that

⟨1⟩ 'C' carrier was one of the original carrier systems. It was capable of deriving three circuits on one pair of wires.

capital was still required to satisfy local demands for service, it was a tribute to the TCTS mode of operation, which relied heavily on compromise and diplomacy among its members, that the system was ever completed. Since then each company's share of TCTS generated revenues has done much to offset the ever increasing cost of local service.

CHAPTER III

The TELEPHONE NETWORK and SERVICES

A knowledge of the basic telephone network configuration and the various types of services offered is necessary to the understanding of the importance and subsequent impact which the CRTC decision, on system interconnection, may have on telecommunications in Canada. The following discussion on the network and services available should provide us with sufficient knowledge to put the subsequent analysis in perspective.

The telephone network as developed and operated by the franchised common carriers in Canada is a complex system in a constant state of change, which integrates the most technologically sophisticated apparatus available into a reliable and easy to use communications facility. The common carriers own and operate the network within their franchised operating areas and interconnect the toll portion at mutual boundaries under the terms and conditions of the TCTS agreement when both participants are members and/or an interconnection agreement setting out the terms and conditions under which the two systems will interchange traffic.

This study will deal with the common carriers associated with TCTS, because they serve 95 percent of the telephones in Canada and they will also face the same problems as Bell Canada assuming that they too will be confronted by CNCP with a request for systems interconnection.

For the purposes of this study we will arbitrarily divide the telephone network into four distinct segments.

Local Switched Network - Exchange

- Rural

Toll Network

Business Service Network

The local switched network refers to the switching office (class 5) ⟨1⟩ , loops and inter-office trunking, in a multi-office exchange area, which allows a customer to access, or be accessed by any other customer in the exchange or rural area. The exchange area normally extends from one-quarter to one mile beyond the corporate limits of the town or city involved depending on the densities and distribution of population outside the corporate limits. The exchange area is defined, for each center served, and such definitions are contained in the company tariff.

We chose to split the area served by an office or offices into exchange and rural areas because of the differences in the provisioning and pricing policies applicable to the services provided in each area.

Within the exchange area, service is normally provided on the basis of individual line service for all classifications, with no options for multi-party service. In the rural areas service is provided on a multi-party basis. The maximum number of customers on a line is four, with the average of slightly less than three. The alternative of individual line service is attainable at increased rates. The individual line rates in rural areas become quite substantial, especially the construction charges if excess mileage is involved. No excess mileage charges are associated with the provisioning of

⟨1⟩ See Appendix 1 for explanation of office classifications.

multi-party service, which is considered standard in rural areas. The policies referred to above are as found in the AGT tariff, and though not applied consistently across Canada, could be considered typical for the operation of most TCTS member companies.

No distinction is made in the network between normal business and residential service. The only special consideration given to business customers is to distribute them evenly across the total expanse of common control switchers and to provide additional switches in the line finders serving business customers, in step by step offices, in order to compensate for the higher calling rates normally associated with business service ⟨2⟩ . Other than that no effort is made to modify the local network for business offerings or special services up to and including low speed data.

One portion of the local network not yet discussed but which has special significance to this study is the provisioning of local non switched loops. These loops are provided under a wide variety of terms and conditions, depending on the configuration and conditioning required. Normally a loop consists of a single pair of copper wire with no special conditioning and without access to the local switched network. These loops are provided for four main purposes.

1/ Local private line facilities.

2/ Local portion of extended private line facilities.

3/ Connection to high speed data networks provided by the telephone companies.

4/ Connection of CNCP facilities to their customers.

⟨2⟩ Refer to Chapter VI for information on the various types of switching offices available.

All customers connected to the local switched network with the exception of those utilizing private line facilities exclusively, have access to the toll network. The toll network provides the facilities which enable the telephone customer to call beyond his exchange or rural area to virtually any place in the world. In North America numbering schemes, transmission standards, provisioning and system monitoring are coordinated to the extent that the condition of any portion of the network is known in the central operations control center at any point in time. The North American center is located in New York city while the Canadian center is in Ottawa with each operating company having its own control center for control of its network.

This system of operational control centers, standard numbering scheme and inter toll trunking, as established through the system of office hierarchy as explained in Appendix 1, provides for the reliability and flexibility which currently exists in the toll network. Network reliability is initiated during the provisioning process in the system design and the quality of the equipment provided, but it is maintained and even enhanced through the operating personnel and procedures employed in network administration. It is the experience and knowledge gained in operations, analysed by means of the control system and shared with the system and equipment designers which ensures constant improvement in the total network.

The control centers form the focal point in system operation, and have been developed through experience and technological advancements into a very sophisticated and effective vehicle for testing and monitoring the network. Through direct monitoring, selective testing, direct input of traffic requirements and circuit availability,

and computer analyses of trouble reports, the operations personnel are able to identify trouble spots, existing or developing, and instruct the toll switches to route around them, which facilitates repair of the problem sections.

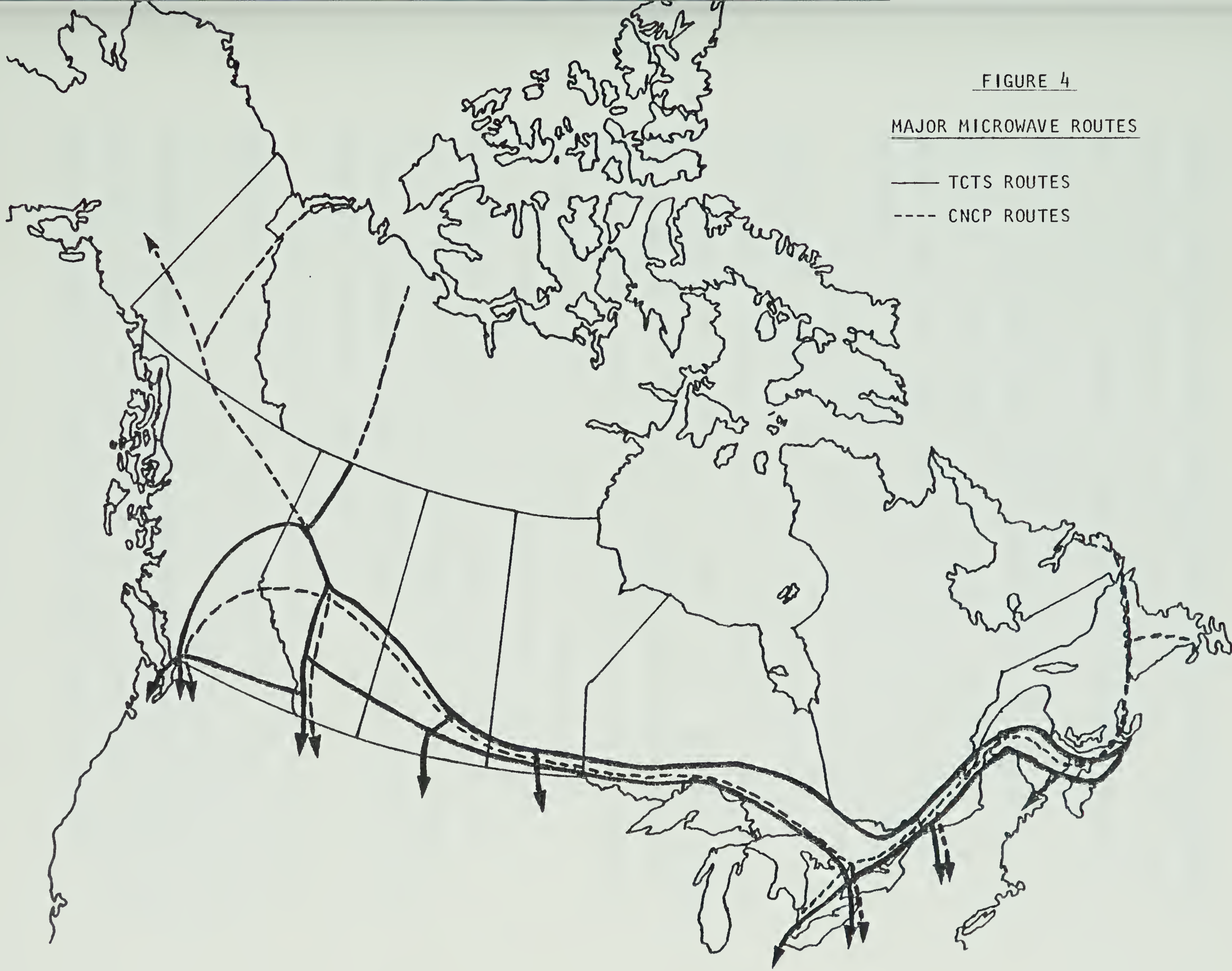
While the previously mentioned provisioning and operating parameters must, by necessity, be coordinated on a continual basis, the participating companies operate entirely independently within their operating areas. In Canada this inter-company coordination of standards, provisioning, network operation and service offerings is provided by TCTS.

It is through these coordinated efforts that, while developing the toll networks within each operating area, the TCTS member companies were able to provision for two completely separate terrestrial microwave links across Canada. The major microwave routes are shown on Figure 4. TCTS also coordinated the involvement of its member companies in their financial commitments to and use of domestic communication satellites, thus ensuring success of the system. Canada was the first country to integrate a communciations satellite into its regular telephone network. As previously mentioned, Telesat has been a participating member of TCTS since 1971.

The inclusion of the satelite into the TCTS network is not as simple or beneficial as it may first appear. The fact that it is a federal crown corporation and that communication companies other than TCTS were also committed to leasing channels, in order to ensure viability of the satellite venture, necessitates commitment of a portion of its circuit capacity to the other communication companies. This leads to some minor administration and access provisioning problems.

FIGURE 4

MAJOR MICROWAVE ROUTES



—— TCTS ROUTES

- - - - CNCP ROUTES

The most serious problem is overcoming the propagation delay caused by the distance in going up to and down from the satellite. This places the constraint on interactive communication of having to place one direction of the circuit on terrestrial facilities.

The fourth segment, which was identified in previous discussions, is the business service network. This network is not an isolated network but rather is a system of separate networks superimposed on, or integrated with, the regular local and toll networks.

The services offered on this network fall into one broad classification, non-basic, with two subgroupings, competitive and discretionary. The business services excluded from this segment are the basic business exchange service which consists of the standard telephone set, the associated white and yellow page standard type listing and access to the toll network for regular message toll service. Some of the discretionary services included are key telephones, PABX's, specialized terminal devices including the broad range of data associated services, private line services, bulk billing of toll services, access to specialized data networks and switches such as Multicom and Datapac and specialized private switched networks such as provided for the federal government.

These services use a variety of facilities and a multitude of combinations of the same. They may be confined to the local switched network, access the regular toll network through the switched network or non switched loops, access specialized switched networks such as multicom or datapac switches via the local switched network, dedicated loops or a combination of same and may consist solely of terminal

devices tied directly to the local switched network with or without restricted toll access.

Services which have access to or gain access via the local switched network cannot be considered as fully competitive services since this form of access has previously been denied to services offered by competitors such as CNCP.

Another general service offering which warrants discussion is extended area service (EAS). This offering, which may be provided under different names and in a variety of ways, allows for unlimited calling between exchange areas, usually in close proximity and with a community of interest, for a flat across-the-board increase in the monthly rate. The increase is usually proportional to the rate prior to the introduction of the service and is normally a function of the number of communities involved, the population of the communities and distances between them.

This service spans the division between exchange and toll service in that it has the characteristics of exchange service but replaces message toll services. Because it moved from the usage sensitive billing concept of toll services to the universal flat rate billing concept of exchange, it is commonly considered to be counter-productive. ⟨3⟩ It is frequently introduced for political expediency.

⟨3⟩ Raymond M. Alden, "Usage-Sensitive Pricing for Exchange Service," New Dimensions in Public Utility Pricing, ed. Harry M. Trebing (East Lansing: Michigan State University Public Utilities Studies, 1976), p. 300.

CHAPTER IV

REGULATION

Regulation, as it applies to a monopolistic or oligopolistic industry, is a legalized system for imposing artifically the controls on that industry and its environment, which would be automatically provided, in a reasonable and fair manner, by the law of supply and demand in a truly competitive market. The reasons such operating environments occur or are allowed to exist are; the industry is capital intensive and the costly duplication or multiplicity of facilities is deemed to be inefficient; the high cost of entry in itself may prevent the formation of a competitive situation; control is required in an oligopolistic industry to prevent the take over by one supplier, through predatory pricing practices, with the subsequent creation of an uncontrolled monopolistic environment. These reasons coupled with the fact that the service provided by regulated industries is normally considered essential, necessitates protection of the consumer from inordinately high prices and requires that the provider of such services receive a reasonable return in order that it can maintain its viability and continue to operate as a going concern. In the telecommunications industry, prior to the advent of interconnection, between 91 and 95 percent of the revenue is generated in a monopolistic environment with the result the consumers of these services must depend on regulation to guarantee a reasonable level of service at fair prices.

In Canada, regulation may be administered at any level of government. The regulated company is normally responsible to the level of government which granted its operating franchise or established the

laws under which the company was incorporated. Three members of TCTS, including Telesat, are regulated by the federal government with the remaining members being regulated by the appropriate provincial government. The municipal governments of Edmonton, Thunder Bay and Prince Rupert regulate the common carriers franchised to provide the local exchange service within their boundaries.

The task of regulation is normally delegated to a quasi judicial agency, legislated into being by the responsible governing body. The enabling legislation usually spells out the terms and conditions under which the operating companies will be regulated. These terms and conditions are, by their very nature, meant to establish the framework under which there is a fair degree of latitude, granted to the regulators, for interpretation and application. This enables the regulators to develop norms and procedures which may be applied in certain situations and particular circumstances without having to resort to legislative action in order to accommodate variations in the operating environment.

In spite of the variations in operating environment faced by the common carriers and their regulatory agencies, there has been a fair degree of consistency in the development of the regulatory bodies and the demands made by them on the common carriers. This has resulted in part from the strong influence exerted by Bell Canada on the smaller companies during the development stages of the industry.

With the exception of B.C. Tel, which is a subsidiary of General Telephones of the United States, the remaining members of TCTS turned to Bell Canada for technical and administrative expertise. Up until December 31, 1976 when AGT dropped the service agreement with Bell

Canada, all TCTS members, again excluding BC Tel, had a working agreement with Bell Canada for the supply of technical and administrative practices and the provision of consulting services on an as required basis.

From this centralized source for operating expertise there developed a high degree of similarity in the structure and operation of each company particularly in the system of accounts. This consistency in operation and record keeping was naturally transmitted to the regulatory agencies, which are dependent on this information to carry out the regulatory function.

The result of this consistency in the recording and presentation of information, coupled with the natural tendency to keep in touch with industry progress in other parts of the country, has resulted in the development of a reasonably consistent regulatory process for all TCTS members. Saskatchewan Telecommunications is the only exception as they are regulated through orders in council of the provincial cabinet.

Two problems traditionally associated with most forms of regulation are: (1) determining which particular items of investment should be included in the rate base and (2) equating the investment risk to a market situation in order to determine the return on equity.

Items to be included in the rate base have been identified with a high degree of consistency among the regulators and include basically all items of investment related to the operation of the company as a going concern, less accumulated depreciation. Inclusion of an allowance for working capital is universally accepted, although the method of calculation may vary between jurisdictions. The same holds true for the

exclusion of plant under construction. Another item of variance is the time of year at which the rate base is determined, beginning or end of year or the use of an average plant balance, with the latter being the most prevalent.

The rate base has been a major target for intervenors primarily because of its visibility ⟨1⟩ and its direct relation to the revenue which the utility is allowed to earn. As identified by W.G. Shepherd, Bell Telephone in the U.S., in an effort to discredit the importance of the rate base, succeeded in focussing everyone's attention on it. The intervenors claim that utilities tend to be inefficient in capital expenditures in an attempt to build up the rate base thus increasing their allowable revenue. ⟨2⟩ The much publicized Averch-Johnson effect states that if the rate of return allowed exceeds the cost of money, the capital labor ratio will exceed the optimum lever relative to efficiency, forms the basis for most interventions of this kind.

Determination of the allowable rate of return on debt capital is not too complex in that the operating company must earn enough revenue, over and above other operating expenses, to service the debt. Therefore the rate is directly related to the average cost of debt capital employed, which in turn, is a reflection of the conditions existing in the money market (uncontrollable) and the financial performance of the company which may be directly affected by the

⟨1⟩ William G. Shepherd, "Pricing Practices in Transition," New Dimensions in Public Utility Pricing, ed. Harry M. Trebing (East Lansing: Michigan State University Public Utilities Studies, 1976), p. 126.

⟨2⟩ H. Averch and L.L. Johnson, "Behavior of the Firm Under Regulatory Constraint," American Economic Revue, Ll1 (December, 1962), p. 1059.

decisions of both the management and regulators. The rate of return allowed on debt capital is, because of the averaging of historical cost of debt, a reflection of the past and current performance of both the company and the money markets. The money market, which reflects the overall state of the economy, sets the range of rates at which capital may be borrowed while the companies performance and financial stability determines at what end of that range that particular company may borrow. The prairie telephone companies, Alberta Government Telephones, Saskatchewan Telecommunications and Manitoba Telephone System, because of their close association with the provincial governments, have the governments borrow money on their behalf or at a minimum have them guarantee the loan which normally assures a triple A rating, resulting in rates at the lower end of the range.

Determining the allowable return on the equity portion of the rate base is much more difficult. The financial viability of the company is of prime importance, therefore in the case of privately held companies, consideration must be given to the companies' ability to generate funds to service debt, provide for dividend payments and to finance a portion of the capital growth. This type of financial viability is required to ensure a reasonable cost for both debt and equity capital. The return must also be established at a rate equal to, or slightly above, the rate obtainable for investments of equal risk.

When setting the allowable rate of return on equity capital, the regulator must have knowledge as to the carrier's future capital requirements so as to be able to evaluate the financial impact of additional service demands which he may impose on the carrier. In most cases the rate of return on equity relates directly to the carrier's

ability to attract new capital. If large amounts of capital are required, an increase in rates may be necessary to attract that capital.

It is the level of participation by the intervenor which has prompted many of the changes in the regulatory process that have taken place over the last couple of decades. During the majority of years over which the industry and regulatory procedures were evolving, there was relatively little interaction in public hearings, which were required by most regulatory agencies when changes to price levels or services were being requested. This was due, in part, to infrequent requests for change and the greater respect or finality with which government dictates were accepted by consumers.

In the late 1960's and early 1970's, special interest groups began to participate as intervenors in order to promote their particular interests in the communication industry. They enlisted other business enterprises, who would also stand to benefit from the adoption of their position, to participate in the hearings. This type of action started with the Carterfone ⟨3⟩ intervention in the United States. The resulting approval by the Federal Communications Commission (FCC) for interconnection, and the associated publicity, prompted further actions of this type. Applications for terminal interconnection as represented by Carterfone example were followed by an application to operate transmission facilities for particular services such as data transmission. The first action of this sort was initiated by Data Transmission Company (Datran) in November 1969 with the FCC setting down a favorable ruling on June 3, 1971. Datran was followed into the field

⟨3⟩ Bruce M. Owen and Ronald Braeutigam, The Regulation Game (Cambridge, Mass.: Ballinger Publishing Company, 1978), pp. 231 & 257.

by MCI Telecommunications Corporation (MCI) who, instead of providing data capability on a digital network, provided for data and voice services on a conventional analog facility. This group of carriers were referred to as specialized common carriers (SCC's).

The next group identified and accepted into the competitive communications scenario by the Federal Communications Commission, were the Value Added Network Carriers (VAN's). This group leases facilities from the common carriers on a bulk basis and re-sells them in customized configuration to their customers. This procedure is in direct conflict with the leasing terms contained in the tariffs of most TCTS members, which prohibits the resale of leased facilities.

The publicity associated with these actions in the United States has prompted similar participation in Canadian regulatory procedures. Although Canadian procedures allow for intervention by interested and involved parties, the common carriers are not required to advertise upcoming applications to the extent of their American counterparts, particularly when it involves application for the introduction or pricing of new services. In spite of lower advertising requirements, intervention by all types of consumers has grown, aided in part by increased awareness as a result of better communications, and the growth in consumerism which has flourished under persistent and growing inflation.

The regulatory hearing, including intervention, provides a very valuable forum for the interchange of ideas between the involved parties. This provides invaluable assistance to the regulator in achieving the ultimate objective of more effective regulation. It allows the utility to explain, clarify and present its position as to

the need for its request, while at the same time receive input from the users as to the probable effect on them, of the proposed change. The utility also has the opportunity to obtain feedback from the consumers and regulators as to the degree of acceptance or rejection of their proposal. The consumers have the opportunity to present their case while at the same time question in detail the utility and the regulator as to why particular courses of action are being followed. The regulator has the concerned parties available for further questioning as to purpose and intent of the application and intervention. The politician, though usually not directly involved, has an excellent opportunity to evaluate the inputs and questions and obtain a reasonably true assessment of the effectiveness of existing policy with identification of the corresponding weaknesses and possible courses of action required to rectify same.

The level of intervention has grown and will rise even further with increased acceptance and application of the recently introduced policy whereby a portion of the intervenors costs are assessed to the applicant in relation to the effectiveness and beneficial effect of the intervention. If, in the opinion of the regulatory body, the intervention is totally self serving in intent or presentation, or of such poor quality that no benefits accrue to the general public or to those involved in the hearing, all costs will be borne by the intervenor. The portion of the intervenors' cost assessed to the applicant will be directly related to the quality and applicability of the intervention as evaluated by the regulator. This will be of particular importance to consumer groups who don't have access to the funds required to avail themselves of the expertise necessary to make a

meaningful contribution. These groups will be restricted to expressing their opinion as to the short range effect on them of the applicants' proposed change to the tariffs or levels of service.

To this point it would appear that regulation in Canada is a reasonably effective mechanism for protecting the consumer from predatory pricing techniques or poor service being offered by suppliers operating in a non-competitive environment. In spite of maintenance of a reasonable level of service in the past, there are three major problems faced by the industry which, unless they are resolved, preclude responsive and effective regulation. These problems are:

1. Jurisdictional disputes between Federal and Provincial Governments over control over the various aspects of communications.
2. Lack of a comprehensive policy outlining the responsibilities of the various participants in the communications industry.
3. The system of accounts, maintained by the carriers, which prevents any meaningful analyses, primarily in the area of causally relating costs to services.

The jurisdictional problem is the most difficult to resolve in that it cannot be dealt with in isolation. The Federal-Provincial conflict has been ongoing since confederation and encompasses virtually every aspect of the control of commerce and life in Canada, and there appears to be a great reluctance among politicians to isolate and resolve any one issue for fear of losing bargaining position on another issue.

In focusing on communications, the major disputes are control over licensing and provisioning for cable television (CATV) and control over interprovincial traffic. The cable television problem is one of definition, the Federal Government classifies cable television as a broadcast enterprise while the provincial governments maintain it is non broadcast because the signals are transported by the cable and are not allowed to cross jurisdictional boundaries indiscriminately. The control over CATV allows the governing body to rule on content and the manner of provisioning. The importance of these issues varies between provinces. For some provinces the issue is economic, for others it is a cultural matter, dealing with control of content, and for all it is part of the federal-provincial power struggle.

The second jurisdictional issue appears more easily resolvable in that the intent of the enabling legislation is clearer and because a similar example exists, in a resolved form, in the United States. Interstate traffic in the United States falls under Federal jurisdiction, Federal Communication Commission (FCC), while intrastate is under the contol of the State regulatory agency.

To this time, no regulatory agency in Canada has taken direct responsibility for establishing inter-jurisdictional rates, although in the federal legislation it is reasonably clear, that the CRTC has such authority and, in fact, they appear to be moving in that direction. Up until now the rates as such have not been regulated, but the resulting revenues have been included in the calculation of allowable returns of each regional carrier as established by the governing regulatory agencies.

The CRTC in recent hearings involving Bell and BC Tel have requested information which will enable them to regulate the toll rates associated with TCTS activity. As mentioned in Chapter 1, TCTS is not a legal entity, but through its regulatory responsibilities the CRTC has expressed interest in reviewing the procedures by which revenues earned through TCTS activities are distributed to the member companies under its jurisdiction.

The provincial regulatory agencies have all expressed a degree of reluctance in acceding to the CRTC's desire to control interprovincial toll rates. ⟨4⟩ This reluctance has been expressed in even more direct terms by the governments of the prairie provinces, which own the major common carriers within their boundaries. This is particularly true of Alberta which has initiated a suit, aimed at preventing the CRTC from using or making public, data on the operations of Alberta Government Telephones, which the CRTC obtained from TCTS by means of a subpoena originated in a Bell Canada rate hearing in March 1980. This type of information is necessary if the CRTC is to determine the amount of revenue Bell Canada or BC Tel should receive from their involvement in TCTS activities.

Partially as a result of the jurisdictional disputes coupled with the Federal Governments reluctance to come to grips with the problem, there is an obvious lack of a clear communications policy which prevents the establishment of detailed guidelines for the development of

⟨4⟩ This disagrees with the position of the agency preceeding the CRTC as expressed in Hartle's Regulation of Communications in Canada. Douglas G. Hartle, "The Regulation of Communications in Canada," Government Regulation, A Series of Papers Edited by the Ontario Economic Council (Toronto: 1978), p. 193.

the communications industry in Canada. The communications industry in this sense must, by necessity, include the cable television industry, data processing industry and the communications equipment manufacturing industry. The interdependent nature of these activities precludes the establishment of policy to govern this segment of the economy without due consideration being given to the effects on all involved.

This lack of policy and the associated guidelines affect orderly development in all areas, including regulation, with the probable result that a Canadian industry which is competitive on an international scale, will either lose its competitive position or be forced into moving its base of operations to an environment more conducive to growth. Northern Telecommunications has undertaken most of its recent manufacturing growth in the United Sates and, if it was not for its close financial and operational ties with Bell Canada, a higher percentage of its operation would probably be in the United States.

The provisioning and development segments are also being stifled by the lack of direction, in that in such a capital intensive industry few enterprises are going to make a major commitment without knowing the rules of the game.

The final area of major concern to the regulators is their inability to effectively assess a company's performance. The primary source of this problem is the archaic system of accounts which has grown up with the industry. Without the ability to realistically determine operating efficiency, it is difficult to assess the necessity of major investments which increase the rate base, or evaluate the operating effectiveness of the company without:

a) making numerous allocation assumptions which render the calculations virtually meaningless; and

b) getting involved in detailed analysis of the day to day operation of the company which would with a high degree of probability, prove to be cost ineffective.

The existing accounting system also makes it difficult for the regulator to relate costs to services on a causal basis. Administration of the pricing concepts discussed in the following chapter would be much more meaningful and realistic if the effect of their application could be more accurately assessed.

In the hearings on Hi-Lo rates which AT & T attempted to introduce in response to competition by MCI, the FCC ruled in an interim decision, handed down January 16, 1976, that the rates be rejected on the basis that the accounting evidence required to support application of the rates was not readily available in either Bell's system of accounts or the working papers presented. ⟨5⟩

Positive steps are now being taken by the regulators in both Canada and United States to have the operating companies introduce a system of accounts which allows for allocation of costs on a causal basis as relate to services provided. The FCC has developed a system of specific account categories, while the CRTC is developing guidelines. There is no doubt that implementation of either recommendation will prove very costly but should result in improved regulation, more effective management of the complying companies, and more meaningful regulatory intervention by interested groups.

⟨5⟩ Owen and Braeutigam, op. cit., pp. 228-229

CHAPTER V

PRICING POLICIES of TELEPHONE COMPANIES

The pricing policies employed by the various telephone companies in Northern America are not rigid, but they do contain a few basic concepts which are applied in a relatively consistent manner. These concepts were developed over the years by the operating companies in conjunction with the regulators, for application in a monopolistic environment. The basic concepts ⟨1⟩ of "value of service", rate averaging and cross-subsidization are not unique to the telephone industry, but are normally utilized, in varying degrees, in the pricing of most services offered by utilities. In many instances, though not with the same degree of consistency, they are used by firms outside the utility field.

The "value of service" concept stipulates that the price paid for various services, primarily basic, is dependent not on the cost of providing that particular service, but on the benefits received by the customer as evaluated by the telephone company. Since determination of the absolute value of the service provided is impossible, and that at the very best only a subjective estimate of the relative value is at all discernable, implementation of this concept relies primarily on experience and historical data, rather than rigorous application of any economic theory.

The elimination of pricing trials by the regulators prevents the derivation of realistic price elasticity measures which could be a

⟨1⟩ Charles H. Garity, "Value of Service Pricing and Development of Rate Schedules", <u>Alberta Government Telephones Evidence in Chief</u> for Rate Hearing Before the Public Utilities Board of Alberta (Calgary: 1977).

very useful tool in establishing fair and reasonable prices. Without empirical knowledge of the price levels at which identifiable groups of consumers would obtain more utility from other forms of communication, or other groups would consider telephone service prohibitive, the determination of what point the common carrier should introduce alternate forms of pricing for basic services becomes very complicated.

Boyd L. Nelson, in his study titled "Problems in the Analysis of Telecommunications Demand", ⟨2⟩ considered various methods, models and econometric studies and concluded anything short of a well designed trial would yield little in the way of significant data. He attributed the problem to a lack of appropriate data and the interdependency of the causal factors associated the variables involved. The difficulties he discussed should have eased somewhat since the article was written in 1976 due to improved study procedures and the availability of data, on calling patterns, from the more advanced switching machines now in service.

Rate averaging is the application of a single rate or tariff for the provision of a particular service, independent of the costs incurred in providing that service in a specific instance or location. Rate averaging takes place within the confines of a single service and is applied primarily to basic services, both local and toll, and to a lesser degree in competitive services where rates are more dependent on causal costs.

⟨2⟩ Boyd L. Nelson, "Analysis of Telecommunications Demand", New Dimensions in Public Utility Pricing, ed. Harry M. Trebing (East Lansing: Michigan State University Public Utilities Studies, 1976), p. 319.

Use of the rate averaging concept eliminates many problems and costs associated with the development and application of many rates to the variety of services offered by the telephone company. It introduces the problems associated with justifying higher rates in the more accessable and less costly service areas and increased pressures by would be competitors for entry into communications in these same areas.

Cross-subsidization is the use of excess revenue from one service or area of operation to subsidize the cost of providing service to another geographic area or customer in a particular service classification.

These basic pricing concepts are applied in a reasonably uniform manner in the areas served by TCTS members and were introduced into the price setting procedures virtually with the advent of operating telephone companies. Although the communications industry has experienced extraordinary technical changes since that time, the reasons supporting utilization of these concepts are still valid and have been legitimized and even encouraged through rate approval by regulatory agencies.

These concepts are applied in concert with the dictates of the constraints associated with the provisioning and operation of the switched network. One economic constraint evident in exchange areas which differs from most provisioning processes is absence of the normal reduction in unit costs usually associated with an increase in the number of units provided. Unlike the power or natural gas utilities where customers are served from main trunks with passive connections to the network, each new telephone customer must be provided with the means to access or be accessed by every other customer. This is accomplished

by providing switching machines to supply the interacting capability and a pair of copper wires from the switching office to the customers premises to provide access to the switching machine. Switching machines are not provided with an unlimited number of paths but are engineered to only block a certain number of calls in a hundred during the busy hour of the busiest day during the year, depending on the level of service being provided. This allows for some savings but most economies associated with scale are derived from operation of, rather than provisioning of the network.

There are economies of scale associated with both the operation and provisioning of toll facilities. These economies, measured in costs per circuit mile, are normally associated with long accessable routes which have the larger cross sections. These economies have been further enhanced in recent years with the rapid advances in solid state technology which has resulted in substantial improvements in reliability and reductions in the dollar cost per channel of multiplex and radio equipment. Although technology has proven to be an able foe for inflation over the past ten years, recent indications are that channelizing costs will start to move upward once more.

Starting from this point, a picture of the relative costs of provisioning and operating of a telephone network begin to appear. The cost of providing rural service, even with 4 party service on carrier derived pairs is very expensive. The provisioning of exchange service in small remote centers with high start up costs and relatively high maintainance costs would be hard to justify economically, on a stand alone basis. The provisioning of toll facilities, with small cross sections, into these remote areas may also be uneconomic. Switching

centers the size of Red Deer or Medicine Hat with two to four 10,000 line units housed in one building with the associated toll switch, and where the outside plant loops do not exceed the 4½ to 5 mile optimal design length, should prove to be the most economical from the combination of provisioning and operating costs. The inter office trunking costs for large multi-office cities like Calgary and Edmonton tend to invert again the economies associated with large scale operations. In this portion of the discussion no consideration has been given to the effect of combining digital switching machines and digital transmission facilities for the provision of inter-office trunking. Implementation of this recent technological advance should provide for reductions in interoffice trunking costs.

Considering the preceding discussion, we may now begin to analyse the application of the basic pricing concepts and the effect this has had on the development of the network. We will also look at the impact these policies have had in creating the demand for increased competition in communication, which the telephone companies and regulators are experiencing all across Canada and the United States.

These basic concepts, as previously mentioned, have been applied with a high degree of consistency in both the Unites States and Canada. The basic concepts have been incorporated into the pricing proposals made by the telephone companies and legitimized through approval of the rate structure by the regulatory agencies. The support of the regulatory agencies was partially prompted by the desire on the part of the politicians to attain "universal penetration," which means that every citizen has ready access to a telephone capable of providing

reliable service. An affordable price structure for basic service has been accepted as a realistic tool for achieving this objective.

Universal penetration has been presented as both a beneficial social and economic objective. The economic benefit refers to the provisioning and servicing efficiencies available to the telephone company when everyone in an area contracts for telephone service. The aspect of economic benefit may be extended to include the expanded consumer market available to business operations, and could be considered as partial justification for higher business rates. The social benefit refers to service being available in all regions and at reasonable rates. This promotes development in remote areas and provides for basic service at a reasonable cost to people having limited incomes. The telephone allows these people to have access to assistance in emergent situations. The latter is particularly true of the aged or infirm who live alone and rely on the telephone for access to social services.

The following is a point summary of how these basic concepts affect the pricing strategy. ⟨3⟩

1. The value of the service increases in proportion to the number of telephones accessible.
2. Business service has a greater value than residential service.
3. Long distance calls originated during business hours shall be assessed the highest tariff.

⟨3⟩ Garity, <u>op. cit.</u>

4. Based on the premise of universal penetration, residential service shall be the first service to receive the benefits of cross-subsidization.

5. All non-basic services shall contribute to the net income of the telephone company. These services cannot be priced below the marginal costs incurred in providing the service.

Once a telephone company has received the approval from its regulator to increase its rate of return, it must then determine the rate increase necessary for each service to generate required revenue. The rate section then proceeds as follows, based on experience and historical data.

1. The first area to be considered is that of non-basic services. This covers terminal devices such as extensions, PABX's, specialized data offerings, bulk toll packages and private line services. These are services which, from the customers point of view, are discretionary or are primarily business oriented.

2. Toll services are then considered from the point of view of total net revenue. Rates may be raised or lowered in an attempt to generate more revenue. Any traffic which can be generated in off peak hours makes a high marginal contribution to net revenue, as long as it is not traffic which has been displaced from the higher tariff periods.

3. Service calls have tended in recent years to be priced closer to actual costs. This is the result of two separate developments:

(a) Rapidly increasing labour costs which must be reflected in the one time service charge.

(b) The customer has been offered an alternative in the phone stores whereby trips to the customer location are eliminated, with the result that connect-disconnect charges are substantially reduced.

4. Increases are considered for the basic exchange service, business first and residential as a last resort.

The fundamental pricing strategy is to increase the cost of discretionary and business offerings first, and then if more revenue is required to proceed to the basic services, with increases to the standard residential service being avoided if at all possible.

This strategy is not new and has been in effect since the founding of the telephone industry. Without the benefit of traffic studies to determine the relative usage of central office equipment by a typical business or residential customer, the rates quoted at the turn of the century to business customers for basically the same service were anywhere from 14% to 100% higher than the residential rate. This is consistent with the price elasticity expected with business as opposed to residential service. Without the benefit of empirical data we would expect that business service would have a lower price elasticity than residential service.

The result of this pricing policy, as utilizied by the telephone companies, and interpretation of social need and its application by the regulatory agencies across Canada, has resulted in significant variations in the pricing structure. The matrices on pages 54 and 55 give the prices for a few standard services and the percentage

of each companies revenue derived from toll related services. This is particularly true of the prairie telephone companies. These matrices along with the graph on page 56 provide an indication of the tendency to depend on toll revenue for a large portion of total revenue, in spite of the fact that investment is heavily weighted in favour of exchange plant.

This situation has developed over the years through the combined action of the telephone companies, the regulators and advancements in technology, which until now have allowed for improved cost effectiveness in the provisioning and maintenance of toll facilities in spite of rampant inflation. Of the three, only the effect of technology has been truly positive. Both the regulators and the telephone companies have tended to avoid the issue of relating rates to costs. They have found it easier and more politically expedient to increase the rates on discretionary and business services rather than establish a policy which would recognize the true cost of residential exchange service, establish a realistic price, and work towards that objective through a series of rate increases.

The fact that the portions of the toll revenue are used to support local services should not be an issue, in that the local network is used to generate the toll traffic and the design parameters for the local network are made more stringent to satisfy the transmission requirements of the toll network. The question of cross-subsidization is one of degree and a lack of effort on the part of the common carrier to identify the causal costs to the regulator. Costs could be allocated on the basis of traffic usage and the incremental costs of upgrading the design criteria.

TABLE 3

TOLL RATES (1978)

	TOLL MESSAGE RATES						
	3 MINUTE DDD CALL 8 A.M.-6 P.M. EACH ADDITIONAL MINUTE				DISCOUNT PERCENTAGE		Toll Revenue as a Percentage of Total Revenue for 1978
	37-56 Miles	81-110 Miles	145-180 Miles	181-228 Miles	Percentage Reduction 6 am-12 pm	Percentage Reduction 12 pm-8 am	
AGT	.84 .28	1.20 .40	1.56 .52	1.74 .58	35	60	65.8
BELL CANADA	.82 .25	1.09 .34	1.21 .38	1.30 .41	35	60	46.2
BC TEL	.84 .38	1.41 .47	1.68 .56	1.80 .60	35	60	57.9
MTS	.60 .20	.84 .28	1.02 .34	1.08 .36	35	50	60.7
MT & T	1.11 .37	1.47 .49	1.77 .59	1.98 .66	30	60	54.6
TCTS	.91 .28	1.28 .41	1.59 .53	1.79 .59	35	60	
ILLINOIS BELL TELPHONE COMPANY	.65 .16	.80 .20	.82 .22	.94 .24			
SOUTHERN BELL TELEPHONE & TELEG GEORGIA	.64 .21	.89 .29	1.10 .36	1.15 .38			
PACIFIC N.W. BELL WASHINGTON	.87 .24	.99 .28	1.02 .29	1.08 .31	25	50	
N.W. BELL NORTH DAKOTA	.85 .24	1.03 .29	1.09 .31	1.12 .32	20	60	

NOTE: Mileage bands apply to AGT. Rates for other companies were fitted into these bands.

* Top figure represents the rate for a one minute DDD call and bottom figure represents the rate for each additional minute.

TABLE 4

EXCHANGE RATES

	EXCHANGE RATES					
NUMBER OF STATIONS UPPER LIMIT	5000		100,000		500,000	
TELEPHONE COMPANY	Business	Residential	Business	Residential	Business	Residential
AGT	10.65	5.25	15.90	6.10	17.15	6.60
BELL CANADA	12.30	5.55	21.05	7.15	25.10*	7.80*
BC TEL	12.75	6.05	17.70	7.25	21.70	8.05
MTS	7.85	4.30	11.15*	5.15*	15.95#	6.15#
MT & T	18.55	8.95	28.85#	9.95#	28.85	9.95
ILLINOIS BELL TELPHONE COMPANY	15.35	6.40	16.35	6.70	21.35	8.20
SOUTHERN BELL TELEPHONE & TELEG GEORGIA	14.40	7.25	26.00	9.45	31.25	11.30
PACIFIC N.W. BELL WASHINGTON	9.80	5.00	17.15	6.95		
N.W. BELL NORTH DAKOTA	15.20	7.60	20.00*	10.00*	23.65	8.25

* Top of companies band coincides with upper limit.

Companies highest rate band.

Rates obtained from the companies' 1978 rate guide.

Exchange rate is the amount paid for use of the local switched network and one basic telephone set for a one month period.

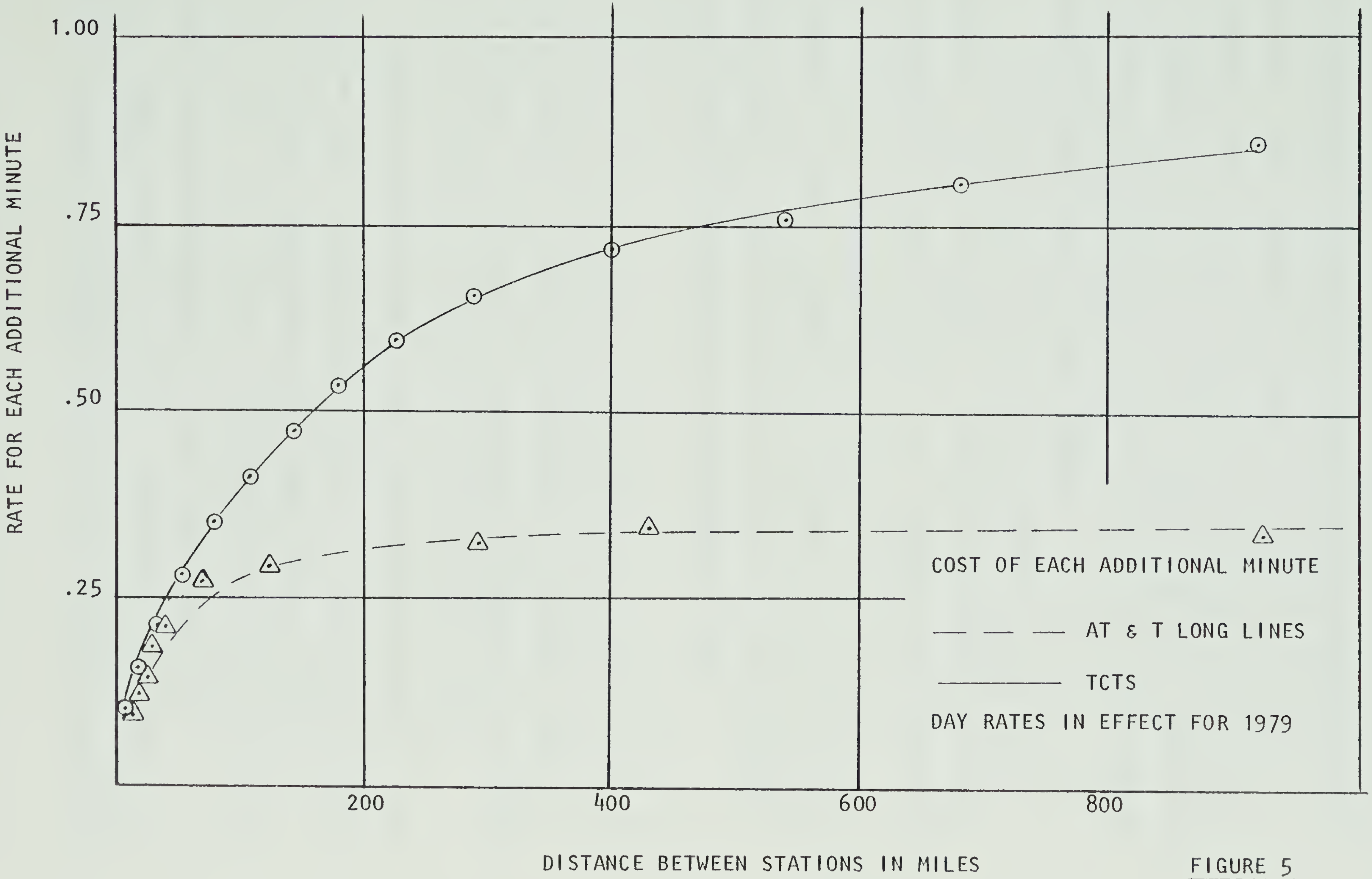

RATE FOR EACH ADDITIONAL MINUTE
1.00
.75
.50
.25
200
400
600
800
DISTANCE BETWEEN STATIONS IN MILES
COST OF EACH ADDITIONAL MINUTE
AT & T LONG LINES
TCTS
DAY RATES IN EFFECT FOR 1979

FIGURE 5

This is not to say that universal penetration is not a desirable objective, but rather the true costs of providing a service should be identified in order that the level of cross-subsidization may be made known. This situation has been tolerated by the business establishment primarily because the costs are passed on to the consumer and also because prior to this decision, there was no direct competition for 93 percent of the telecommunication requirements and other forms of communications were not suitable substitutes.

It has been argued that cross subsidization does not really assist anyone in that the consumer is ultimately responsible for these costs and therefore nothing is gained. This argument may be rebutted by the fact that the telephone customer requiring that the rates be maintained at low levels, referred to as lifeline rates in California, is not the consumer of most other services offered by the businesses which are charged with the majority of the burden for cross-subsidization.

The preceding discussion and the Tables on pages 54 and 55, and the graph on page 56, in spite of the brevity of the sample, begin to give us a picture of the results of the pricing procedure and the effect on this of the operating environment for that particular company.

Canadian companies tend to have lower exchange rates and higher toll rates than their American counter parts. It is also interesting to note the relationship between the various intra-company rates and the Trans-Canada rates. The high toll rates of British Columbia Tel could be a reflection on the high cost of the toll facilities in the mountainous regions of British Columbia. The high toll and local rates of Maritime Telephone & Telegraph probably reflect geography, population

distribution and the location of the province. In Nova Scotia, the distances, as determined by a system which tends to reflect the shortest distance between two points, on which tolls are calculated probably does not reflect the lengths of cable and wire required to circumvent the coves and inlets. The distances between centers are not large and therefore high rates are required to generate the required intra-provincial tolls. With only Newfoundland being on the far side of Nova Scotia, the volumes of TCTS through traffic are not large, and therefore do not contribute significantly to total revenues. On the exchange side, the numerous small towns and villages tend to increase the service costs on a unit basis.

A major factor in the lower rates of Manitoba Telephone System and Alberta Government Telephones is the preferred borrowing rates which they both enjoy as result of guarantees by their provincial governments, which eliminates the need for large profits normally required to stimulate the inflow of capital. The rates of Manitoba Telephone System are probably lower than Alberta Government Telephone's for three reasons: lower Capital requirements associated with lower growth rates; a more confined area of operation; and probably a higher degree of TCTS' through toll traffic.

We shall end this chapter on pricing by making the following general observations with respect to the situation which has developed through the application of the pricing concepts.

Universal penetration has been obtained with the level of basic service in remote or frontier development areas virtually indistinguishable from that available in the larger metropolitan areas.

The level of service available in rural areas has increased substantially, particularly in Alberta, with the introduction of four party buried service.

It has been generally accepted that rates for residential, local exchange service, do not cover the cost of providing the service. This is also true in many areas of the United States where the tariff for similar exchange services are substantially higher. The reliance on cross-subsidization from revenues derived from toll services and business services, to make up the shortfall, has been accepted by regulators.

The result of having to cross-subsidize local exchange rates with toll revenues, and average the rates for toll service provided on major toll routes with the rates for toll service provided on minor routes, is the development of toll rates which produce super normal profits on the major toll routes. The source of these profits is more closely defined through the application of higher toll rates during business hours. The super normal profits which are generated by a highly concentrated consumer group accessible through the construction of a relatively inexpensive facility is an open invitation for competitors to request entry into the market and to gain support for such a request.

CHAPTER VI

TECHNOLOGY

The electronics industry, which includes as subsets the computer, communications, and broadcast industries, as well as large portions of the automation and control industries, has been one of the most powerful agents of change in the standard and way of living in modern western societies. The rate of change effected varies as the rate of application of the most recent developments in electronic technology. The ability to store, process and transmit information in all forms has established the basis for increased development rates in practically every field of human endeavor. This communication capability, communication in this instance being used in its broadest sense, has been and shall be the basis for social change as described by Daniel Bell. ⟨1⟩

The social change as described by Daniel Bell details the events and changes in society as it moved from an industrial or material based production mode, in which most effort was directed towards the production of hard goods, to one in which the majority of effort is directed towards the production of services such as health and welfare, education, recreation and finance. This partial list depicts the shift towards the requirement for a larger information base than was necessary for the production of hard goods. This information or knowledge base has been growing for a number of years, which is to be expected since you have an increasing number of qualified people building on an ever

⟨1⟩ Daniel Bell, The Coming of the Post Industrial Society (New York: Basic Books, Incorporated, 1976).

broadening base. Daniel Bell referenced Fremon Rider's study ⟨2⟩ on the Yale Library, in which he predicted a doubling in size every 16 years from 1831 through 1938. Using Rider's Theory, the projected number of volumes in 1938 was 2,600,000 while the actual count was 2,748,000. Studies conducted in the United States indicated that from 1946 to 1964, the population between the ages of 18 to 21 increased from 9.4 million to 11.3 million while enrollment in post secondary schools increased from 2.1 million to 5 million.

This increase in the production and need for processing of information provided both the impetus and capability required for the development of the computer industry and the related technological advancements in the telecommunications industry. The common growth characteristics of these closely related industries are an indication of the universality of the need for processing and dissemination of information and a reflection of their dependence on a common technology.

The single most important factor responsible for the state of communications today has been the technological advances made in the electronics industry. These advances have provided the hardware for the development of the communication systems in place today and promise even more sophisticated and efficient systems in the near future. Hardware based on digital technology, for both switching and transmission systems, is in place, but total replacement of the existing systems will have to be phased in over the next twenty years, in order to allow for incorporation of the most recent technological enhancements and satisfaction of financial constraints.

⟨2⟩ Ibid., pp. 122-128.

Even more important to this study than the application of the new hardware has been the development of systems, based on the new electronic technology, which has increased the demand for new communication services and the ability of other entrepreneurs to provide transmission facilities at reasonable prices. As mentioned in Chapter III, the cost of a circuit mile of transmission facilities including multiplex has been decreasing in spite of constant and significant inflation.

The key element in this technological advance has been the development of the integrated circuit in which discrete electrical components such as resistors, diodes, transistors and capacitors are built up on a chip of silicon. This is done by means of photographic and etching techniques referred to as thin or thick film processes, to form complex circuits consisting of thousands of components set down in layers, whose thickness is measured in microns, on a chip with an area of less than .1 square centimetre. Through consistent emphasis on research and development in this area, the number of components packaged on a chip has increased by a factor of 6 over the past 5 years. The impetus for this type of development has come from the communications and computer industries, backed by government support.

The government support is provided in order to maintain an advantageous position in high technology, human resource based industry with world wide markets and to assure the capability of providing the most sophisticated weapon delivery systems for the military.

The benefits to be derived from increased packaging densities are of prime importance to the computer and communication industries with spin-offs to other users. The main benefits are:

1) Decreased costs per circuit.

2) Decreased distances between components as measured in microns with a corresponding decrease in signal travel time between components, as measured in nano seconds. This results in decreased processing time which translates into high digital sampling rates.

3) Increased reliability because of fewer components.

4) Lower power requirements resulting in lower cooling costs.

5) Smaller equipment packages which translate into less floor space and/or less weight.

The application of this technology in the business environment has resulted in much more efficient methods of handling and processing information. The automated office where all communications, word and data processing and filing are in the electronic mode is a reality in the form of trial offices as designed and produced by various manufacturers. These manufacturers include such diversified and well funded companies, in both human and capital resources, such as International Business Machines (IBM) and Xerox. Automation need not be total before the requirement for increased data communications between branch offices or supplier and consumers of all kinds of services including data processing, begins to place demands on the common carriers to provide services not attainable on the existing switched network.

The existing switched network is comprised of all types of switching offices and carrier facilities which limit the speed and reliability of the data stream to that attainable by the least capable switch or toll facility. Step-by-step offices which utilize updated

versions of the mechanical switch invented by Strowager are still in common use as class 5 offices. This type of switch is prone to the production of hits or electrical impulses on the line, which appear as bits of information in a data stream and are very hard to detect as errors at high transmission rates. This limits locally switched data offerings to speeds below 1200 baud. Step-by-step switches are in the process of being eliminated from the toll network in Canada, but will probably remain in use in smaller centers as class 5 offices for the next 20 years.

The previously mentioned technical advances have been more quickly incorporated into transmission facilities. Miniaturization first appeared in the form of reduced tube size, then moved on to discrete solid state components and then to integrated circuits. The later stage is the current state of the art and has been a key factor in system design over the last 15 years. Over this period packaging densities and reliability have been greatly increased and has prompted the telephone industry to rediscover pulse code modulation (PCM).

PCM consists of quantizing an analog signal, such as the human voice, into a series of on/off digital pulses. The advantage of this method, over the traditional methods of amplitude or frequency modulation, lies in the ability of the signal to be detected and regenerated many times without significant distortion. The digital signal, at the point where amplification is normally required, is detected and the pulses regenerated free from the noise picked up on the previous leg of transmission. When an amplitude or frequency modulated signal requires amplification, the signal is relatively weak and the signal to noise ratio is high. This results in signal distortion as the

noise is amplified along with the signal. Even in the case where distortion of the signal is relatively severe, it is rare when the absence or presence of pulse in its original sequence cannot be detected with sufficient accuracy to enable faultless reconstruction of the original message.

A high degree of fidelity is not as important in the transmission of voice signals as it is in the transmission of data, since the result of slight signal distortions are not discernable by the human ear. Similar distortions in data transmissions are more critical with the effect being more pronounced at higher rates of transmission, therefore use of digital transmission techniques is more beneficial to data users. These benefits are further enhanced by the elimination of signal conversion leaving and entering the computer, in that the digital signal is also the language of the computer.

In summary the transmission portion of the toll network currently consists primarily of analog multiplex and radio systems carried via microwave, coaxial cable and paired cable systems. Digital systems have been in place for the past ten years using "T" screen paired cable as the transmission media. These systems referred to as T-1 systems were able to carry 24 voice channels on two pairs of copper wire. One pair of copper is used for each direction of transmission. The following table gives the various levels of digital carriers and the associated channel capacity and line bit rate in millions of bits per second (MBPS) and the Bell system designation. Most of the current growth or replacement transmission systems utilize digital technology.

Level	T-1	T-2	T-3	T-4
Number of Channels	24	96	672	4032
Line Bit Rate/Mega Bits	1.544	6.312	44.736	274.176
Designation	DS-1	DS-2	DS-3	DS-4

One major problem faced by the designers of radio systems is the efficient use of the radio frequency spectrum. Part of this problem lies in eliminating interference between radio systems. These restrictions do not apply if the system is contained within a cable or wave guide but then the constraints become economic. Copper cables or wave guides become expensive over long distances as opposed to free signals in air or even space. One solution which is currently being tested in many field trials, such as the one proposed by Alberta Government Telephones, is the use of fibre optic cables.

The light systems appear to offer some solutions to the problems associated with operating radio systems in densely populated areas where cross system interference is high and wide spectrums are required. Fibre systems are being considered for interoffice trunking and even local distribution systems in which a fibre optic cable is run into each residence for the purpose of supplying a wide variety of switched services such as video signals, meter reading, alarm distribution, remote surveillance telephone service and data processing access. Digital switches proposed for the late 1980's will use fibre optic technology.

A fibre optic communication system consists of a means of converting electrical signals into coherent light. Currently light emitting diodes (LEDS's) or injection laser diodes are used. At the receiving end either a pin diode (PIN) or an avalanche photo diode (PPD)

may be used to convert the light signal back into an electrical signal. Also required is the transmission media, after which the system is named, the optical fibre. This fibre is a thin strand of glass clad with glass of a different refractive index. The diameter of the inner strand is in the .9 mm range with the cladding being approximately .2 mm thick. Pushed by rising copper costs and the need for the broad spectrum capability, research has resulted in marked improvement in all three major components over the last few years, bringing closer the everyday application of the trial systems now under way.

The advantages associated with the progress made and expected in transmission systems goes for naught if the switching systems are not subject to equal advancement. Though the timing of development has differed switching systems are now catching up from a technical and operating capability view point.

The previously mentioned Strowger switch, subject to modifications and normal development by the various manufacturing concerns, was the backbone of the automatic step by step switching systems in the telephone industry in North America. These switching systems are referred to as step by step (S X S) because the customer controlled the switching process by means of his dial, at each phase or step along the way. As each digit was dialed the switch stepped up to the desired level and passed the customer to the next switch in the chain until the talk path was established through the switch.

In the early 1950's common control cross bar switches were introduced. The switching mechanism in these switches was a series of switching matrixes or cross point array operated by the common control units. The control units, consisting of markers, senders and registers,

detected the request for service, provided dial tone, accepted the digits, determined the machine location of called subscriber, selected and connected a talk path through the switch and then dropped off the common or shared equipment to be available to another customer. When the call was completed the on hook condition was detected and the talk path was disconnected. Although the logic for the control equipment is hard wired, switching was faster and generated less noise, resulting in improved data transmission.

The next step was the introduction of computer controlled switching machines in the late 1960's and early 1970's. As an example Alberta Government Telephones installed its last major cross bar switch in 1970 and placed its first computer controlled machine into service in 1971. Other than replacement of the hard wired logic with a computer, in the common control portion there is not a vast difference in the fundamental operation of the switch. Smaller cross bar switches with similar operating characteristics, were used in the Northern Telcom version while other manufacturers used networks of reed relays to form the cross point array.

Though the fundamental operation was similar, to the hard wired cross bar switch there were advantages for the computer controlled switch such as:

a) Less floor space required.

b) The machine constantly monitored itself in an effort to detect problems before they became service affecting.

c) Loop tests could be programmed and carried out automatically, with printouts being produced for follow up.

d) Offices could be left unattended with trouble printouts being sent to an attended office or trouble reporting centre.

e) Office administration could be accomplished through computer instructions without the need for hard wire changes.

f) Special services such as call waiting, call forwarding and abbreviated dialing were made available, with the computer controlled switch.

The incorporation of the computer directly into the hardware of communications industry, and not simply as an administration or accounting tool, is just beginning. Specialized services such as Datapac, the TCTS packet switching offering, use the computer as an active component in setting up and labelling the information packets and then routing them to their proper terminating switch. At the far end, a computer identifies the customer to receive a particular data packet and arranges that packet in proper sequence with other packets for the same customer and then routes the series of packets to the proper destination.

So far, this simplified explanation has touched on three distinct types of switches that have a major item in common, that is the actual switching is done by electromechanical means and once the talk path is established through the switch, it is held for the duration of the call. The next development in switching which is just now beginning to make inroads into the communication field is the digital switch.

This is the first truly electronic switch in that the switching function is performed by electronic means. The key requirement in this method of switching is that the signal be in a digital format. This

necessitates the signal to be converted from an analog to a digital signal, or the switch be connected to a digital transmission system.

Without getting into the detail necessary to explain how the switch operates, it should be pointed out that for the first time the customer is not assigned a talk path through the switch for the duration of the call. He shares a transmission path through the switch with other callers, with the information contained in 8000 separate samples taken every second for each call being electronically switched to the proper output location. The signal is then converted to a analog signal or connected directly into a digital transmission facility.

We now have a switch that is not only computer controlled but uses the same language as the computer and operates in a manner similar to that of a computer accessing its data banks. The three major components, of what could be envisioned as the communication system of the future, now use the same language and with very little effort in the development of interfaces and protocol, the computers could automatically dial up other computers, identified as sources of input or destination of output, for the purpose of exchanging information. If all links in the switched network were in the digital mode these exchanges could take place at high speed without the requirement for special networks.

In concluding this chapter on technology, three observations shall be highlighted for future reference.

1) The technology is in hand for the establishment of a completely digital switched network capable of handling voice or high speed data communications with equal facility.

2) Due to the pyramiding effect of technological advancement, each switching technology has been subject to more rapid obsolescence than its predecessor. The machines are still functional within their basic design constraints but demands for new services and the need to reduce labor requirements hasten their retirement.

	DOMINANT TECHNOLOGY	INSTALLED LINES ⟨3⟩ 1974	1976	1978
Step-by-Step	1920-1950	60.7	50.4	31.6
Common Control Crossbar	1950-1970	26.8	24.0	19.0
Stored Program Control	1970-1980	12.5	25.6	49.4
Digital Switches (Electronic)	1980- ?			

This situation if accompanied with high growth rates, tends to shorten the service life of the machines.

3) Electronic technology will develop at even faster rates in the future, due primarily to its past success and increased demands for more and better service in the future.

⟨3⟩ Installed for each type of equipment as a percent of the total installed in AGT for 1978.

CHAPTER VII

MARKET

The telecommunications market is a subset of the communications market. It may be described as the transportation market for information. By allowing users to interchange information in a participatory mode, telecommunications becomes a substitute or alternative to transportation of people travelling for the sole purpose of exchanging information.

The telecommunications market is a complex and volatile market operating in an ever changing environment. The pressures and problems originating within the market are equaled in magnitude and degree of difficulty only by the problems introduced or compounded by the participants operating within the telecommunications environment. The market is affected not only by the active participants within the market and environment, but also by the would be or potential participants.

Figure 6 gives a pictorial representation of the market and its environment. Dialogue exists between all participants and is playing an ever increasing role in shaping the development of the market. It has almost reached the point where the market is being restructured on the basis of what participants claim they can do or require, rather than what they are capable of doing or have demonstrated a need for.

For the purpose of market definition the suppliers of communication services are the first three groups identified in Chapter I. Group 1 consists of the CNCP consortium and Group 2 and 3 consists of Bell Canada and the remaining members of TCTS with the exception of

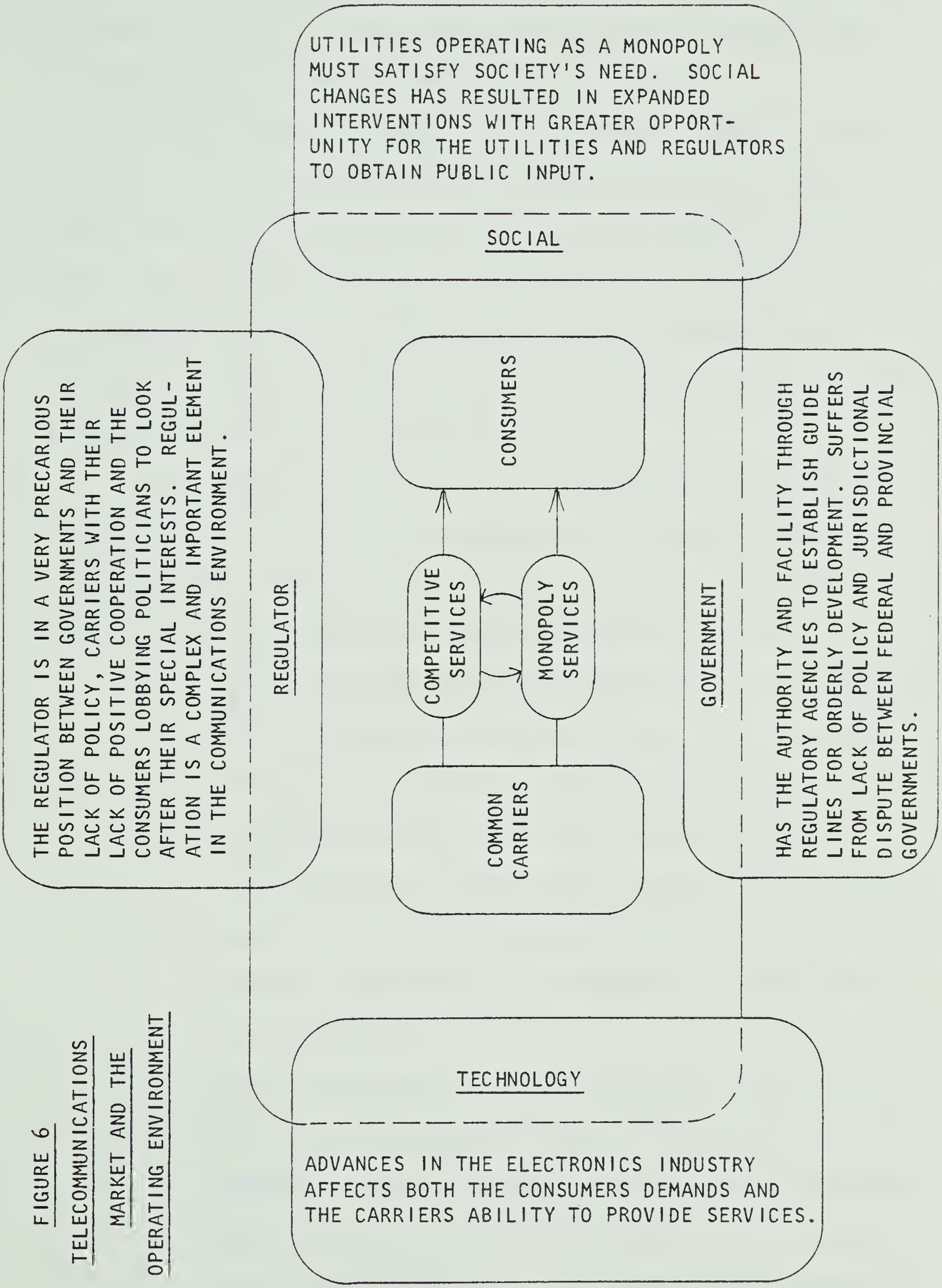


FIGURE 6
TELECOMMUNICATIONS MARKET AND THE OPERATING ENVIRONMENT

Telesat. In this market analysis, Groups 2 and 3 will be considered as one group. Groups 1, 2 and 3 form the major portion of the common carriers in the diagram on Figure 6.

As discussed in Chapter I on problem definition, the common carriers in this discussion are CNCP and Bell Canada, with TCTS and its remaining members, exclusive of Telesat, being considered in unison with Bell. These two groups form the common carriers or suppliers of telecommunication services with the TCTS member companies, which includes Bell Canada, being considered as the only suppliers of monopoly services which affect this discussion.

The consumers can be divided into distinct groups based on their size and ability to effect change in the market. The following groupings though somewhat arbitrary and more refined than identified in Chapter I, are developed to facilitate analysis of the market.

1. Large businesses which are national in scope with branch offices distributed across the country. This includes financial institutions, distribution or franchised enterprises, manufacturing concerns with in-house distribution facilities, nation wide service or resource companies and similar endeavors requiring the ability to transfer large amounts of information to head offices or branch offices.
2. Small businesses are normally comprised of one unit or if more units are involved they are contained within a small geographic area or operate independently of each other.
3. Large and small businesses which are involved in data and/or word processing. This group includes suppliers of

hardware, software, sophisticated office systems and/or machines. It also includes firms offering time share processing or data bank access or both.

4. Governments which operate on a province or nation wide scope are large consumers of communication services. The need to gather and disseminate information from a centralized administration complex clearly demonstrates the requirement for a complete and reliable communications network.

5. Residential telecommunication consumers. This group is being included in our analysis, not because of the effect it has on the market now, but rather its potential to affect the market in the future. Also consideration must be given to what effect changes in the market place will have on the ability of the less affluent residential consumers to afford basic service.

In order to properly assess the impact of major changes to the market structure, it is necessary to determine the revenues generated by particular consumer segments as well as to determine the market shares of the suppliers. The necessity of such analysis is supported by the potential for change, particularly in the transmission segment of the market. This segment has the lowest cost of entry, with the exception of the terminal market, and it has the most potential for super normal profits if the route, cross-section, and potential market are chosen carefully. Many of the consumers identified in the third group have the need and potential to develop the necessary facilities for market entry.

On the following page is Figure 7 showing the broad classification of services offered in the market as developed by CNCP. This diagram was titled "Principal Telecommunications Market" and was designated as Exhibit 13 of their Telecommunications Market Study - 1977 which was submitted to the CRTC in evidence. The addition of local and toll designations were made by the writer to further refine the market segments for future discussion.

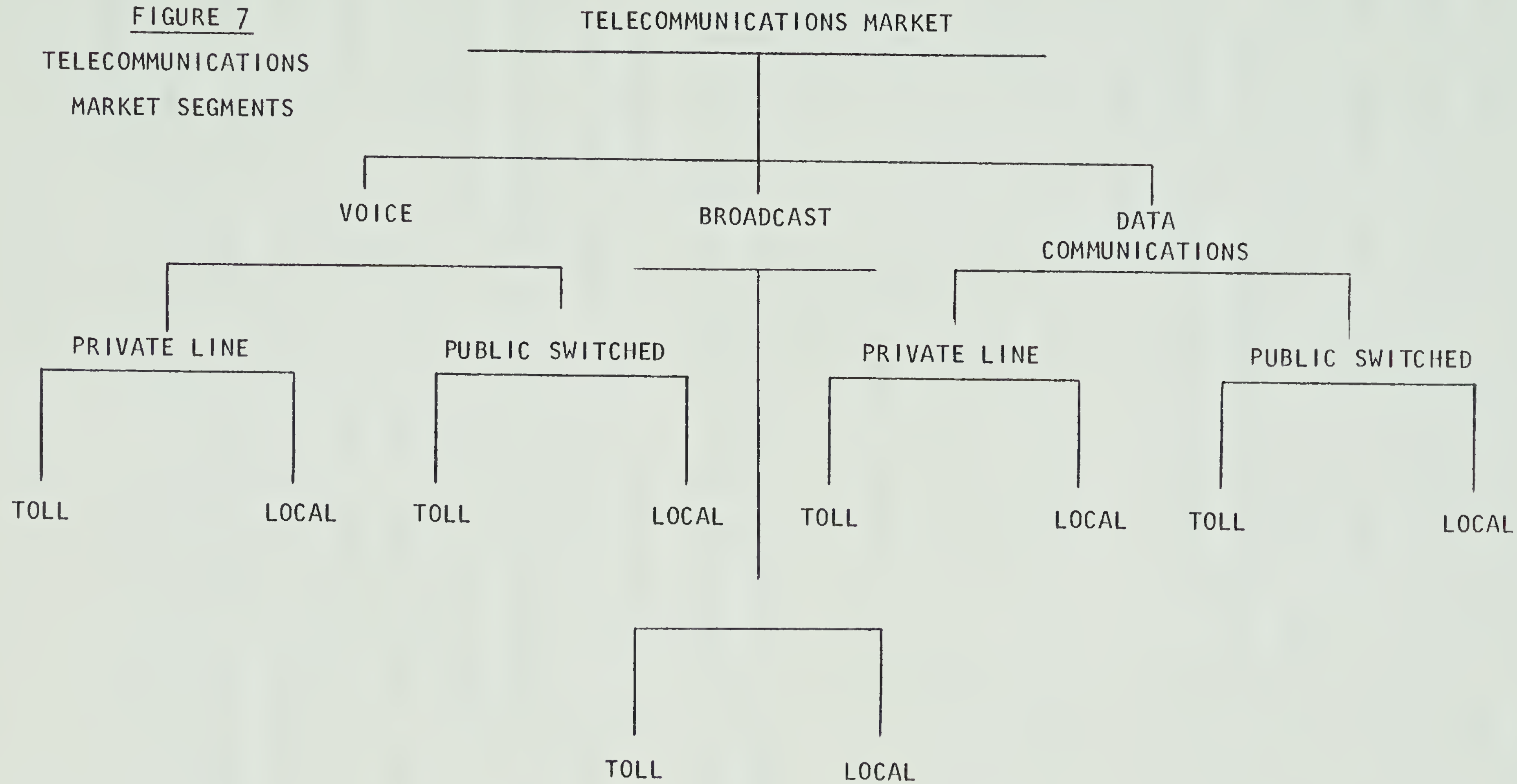
CNCP has access to all market segments shown on Figure 7, except for the Public Switched segment which includes the local switched network and message toll services with its various sub-segments, which are differentiated primarily on the basis of packaging and unit pricing. In the application to the CRTC, CNCP sought access to their services, by current and potential consumers, via the local switched network. This does not allow CNCP to directly participate in the total public switched market segment but it does allow them to offer their customers the opportunity to by-pass the message toll portion of the public switched segment on a dial-up basis.

Table 1 on page 10 and Table 2 on page 11 list the competitive services provided by CNCP and the telephone companies and where applicable, services are grouped according to comparable features and network required.

Prior to proceeding with the market analysis, the validity of the data available should be put into perspective. The company totals on income, expenses and telephone statistics, taken from the Financial Statistics on Canadian Telecommunication Common Carriers are accurate, subject to errors in compilation. The amounts shown for AGT, which were used along with CNCP for evidence as the basis for the competitive

FIGURE 7

TELECOMMUNICATIONS MARKET SEGMENTS



market shares, are true in total, but the allocation to specific market segments is rather arbitrary. This is due, in part, to the lack of consistency between the CNCP service definitions and those used by the TCTS member companies, and difficulty in adapting the traditional system of accounts of the common carriers to accurate reporting by type of service. There are also problems in classifying certain services to particular market segments in that services may be used for more than one type of communication.

We were limited as to data available, and further restricted by the confidentiality of data to which we frequently had access. In other instances the market data was available but only through the development and application of customized computer programs, the cost of which could not be justified by this thesis.

In reviewing the market shares of Appendix 4, strengths and weaknesses of the competitors start to become apparent. CNCP are dominant in message record services. This dominance is due, in part, to the traditional roles played by the competitors. The original telecommunication message record, the telegraph message, was considered as the exclusive property of the railways from the time when telegraph was the only form of telecommunications. The historical claim to this market segment was enhanced in 1956 when CNCP introduced telex, which is basically a switched form of teletype service. This service is connected to similar networks throughout the world, which enables CNCP customers to access other subscribers virtually anywhere in the world, on a dial-up basis.

A significant portion of the message record market segment is derived through the use of private line facilities. These facilities are generally leased by large corporations with fixed, high volume communication patterns. Private line message record services represent 30.1 percent of the message record market with CNCP's share of the total message record market being 88 percent. This market is obviously not one of concern for either combatant since CNCP has the largest share; thus it will not be greatly affected by system interconnection, and the TCTS member companies appear to concede this market based on experience and vested interests.

The private line voice market segment is a significant segment which is accessible to CNCP. In spite of this accessibility, CNCP has only 8 percent of the private line voice market. This could be due in part to segment definition and lack of consistency in the market evaluation as determined by CNCP and the figures developed in this thesis.

CNCP's small share of this particular market segment could also be the result of the inherent voice capability in the private line message record service provided by CNCP which nulifies the requirement for the customer to buy an additional service. Part of this low market share could be attributed to the refusal on the part of the telephone companies to provide for a type 2 connection, ⟨1⟩ which prevents the connection of CNCP circuit facilities to the telephone companies terminal equipment which is in turn connected to the switched network. The consumer, rather than accept the increased inconvenience and

⟨1⟩ See Figure 2 on page 4 of this thesis.

terminal equipment charges, would probably lease the private line facilities from the telephone company. The practice of by-passing the toll network by off ending calls through the terminating switchboard of a private line facility is widespread and may in some instances be the only economic justification for the leasing of private line facilities.

The computer communications market segment is the most important of the three market segments identified in this study. As identified in the previous chapter, the information explosion resulting from the rapid developments in the computer industry and the parallel development in communications, is resulting in increased demand for improved data communications.

Data Communications is the fastest growing of the three market segments for the TCTS member companies. Although current figures are not available, the rate of growth reference is probably also true of CNCP, judging from their interest and emphasis on system development in this segment.

This market segment requires further definition because of its importance and volatility, from both a technical and market demand point of view. This segment includes services which provide for the interactive exchange of data in machine language. The services provided under this definition are continually expanding as we move closer to the "Mechanized Office of the Future", and the "Wired City" concepts, but, even in the current time frame, word processing, which includes storage cataloging and retrieval, is gaining in relative importance with data processing resulting in increased demand for computer communication.

It is the development of, and access to, vast amounts of data which must be processed to suit the user's needs which is generating the expanding impetus for fast, reliable, and confidential data communication networks. The information explosion referred to in Chapter VI is having its greatest effect on this market segment.

The market shares for 1976 show CNCP gross revenues at 15.5 million dollars which represents 12 percent of this market segment. This may appear disproportioned between TCTS Member Companies and CNCP, but if the ratio of computer communications on private line to the total computer communications revenue is consistent with that of AGT, then CNCP has access to over 65% of the total market.

There is one portion of this market segment to which CNCP did not have access, prior to the CRTC decision for Bell Canada to provide for type 1 interconnection, and that is point of sale credit verification. This service requires that the consumer, the retail store, have access to the credit verification centre for each type of major credit card. For maximum flexibility this is best done on a dial up basis, whether the information is passed verbally, via the key pad on the telephone, or via an automatic reader with the supplementary information keyed in.

These services, such as credit verification, which are typified by the transfer of small quantities of information originated from many locations, are the types of services which CNCP has been unable to provide prior to the granting of system interconnection by the CRTC. This includes users of low speed dial up data processing and firms involved in sales whose salesmen employ a dial up computer controlled

ordering procedure from the customers location. The consumers of these services would fall under group 2, and, in some instances group 3 as defined earlier in this chapter.

The previously referenced type of instantaneous data processing is necessary for the survival of smaller businesses. Close, accurate control of inventory and cash flow is mandatory in the inflationary environment in which they now operate. The key to this type of information processing for the smaller firms is the flexibility associated with dial up access.

In spite of the growth associated in the flexible access portion of the computer communications market segment, the largest portion of revenues in this market is generated by the high volume limited access customers. These customers require access to a limited number of predetermined points on high speed networks with limited switching capability. The high speed transmission requirements preclude access through the local switched network until such time as the local machines, at least in the larger centres, operate in the digital mode. This would require the provision of local loops with the proper conditioning, connecting both the originating and terminating consumers apparatus to networks such as Datapac or Infoswitch.

The consumers of these large volume data services would be from groups 1, 3 and 4 and could be served by either CNCP or TCTS member companies.

In reviewing this market analysis it appears that CNCP has had access to 65 percent of the data market prior to the CRTC ruling, but has failed to capitalize on it. The reasons for this are probably attributable, at least in part, to their failure to offer anything

different in the way of services or pricing structure than is being offered by the TCTS member companies. Their failure to press for a larger share of dedicated access data market may be an indication that the viability of the CNCP consortium is not really in question.

System interconnection will allow CNCP to pursue the faster growing, more readily influenced, flexible access data market. Once the consumer has established that there is no apparent penalty in accepting the CNCP offering, the advantages which CNCP would have to offer in order to perpetrate a change, would not have to be significant.

If CNCP were to obtain permission for system interconnection with the remaining members of TCTS, their ability to penetrate the flexible access market would be further enhanced. This would significantly affect the profit picture of the TCTS member companies, particularly the prairie telephone companies, since a larger portion of their net income is derived from toll and data services.

The problems this created would be further aggravated by establishing a prerequisite for the entry of other specialized carriers. An increase in specialized carriers would in turn result in increased pressure on the telephone companies to increase their capital expenditures in order to more rapidly implement the digital switched network, as discussed in the previous chapter.

CHAPTER VIII

EFFECT of CHANGE

Implementation in the rest of Canada of the interconnection proposals which the CRTC has ordered Bell Canada to provide for CNCP in Quebec and Ontario would affect practically every segment of the competitive markets and pose a significant threat to the common carriers revenues from message toll service.

The competitive market segment in which the greatest impact would be felt would be computer communications. In 1978 the TCTS common carriers share of this market was calculated as being 202 million dollars, of which 74 percent was derived from the provision of toll services.

It is this type of service which is most vulnerable to competitive pressures for four reasons.

1) Over 60 percent of the services are generated by 15 percent of the business customers. The marketing effort of the would-be competitors could be concentrated and consequently more effective.
2) These customers are located in, and usually demand service between, the major population centers where CNCP have existing toll facilities. The consumers are readily accessible without having to build new and costly facilities to remote areas.
3) The higher percentage of the revenue, in this case 74 percent, is generated by toll services which provides for

the most efficient utilization of capital and operational resources.

4) It is the fastest growing market segment, thus any incremental investment is readily justified and quickly recovered.

The first three reasons are related to the previously mentioned efficiencies which are normally associated with the provisioning and maintenance of toll facilities. The fourth reason may be considered as supportive of CNCP's argument of market stimulation through competition, whereas the growth in part may be the result of service substitution of non competitive message toll. The degree of substitution shall remain unknown since studies were unavailable on cross elasticity between telecommunication services. The probability of the market being stimulated to any measurable degree by the competitive activities of the telecommunication vendors is remote. Growth in the computer communications market segment is primarily the result of a need for more cost efficient management systems to combat spiralling inflation and operating uncertainties. Advances in the availability of data and word processing equipment, improved access to time share processing, and the trend to make most of this equipment interactive, and for more than one purpose, will stimulate further growth in this market segment.

This market segment has experienced an average increase in sales of over 30 percent (see Appendix 6). This growth rate may appear high, but remains substantially below that forecasted for the next decade.

This growth rate may be interpreted or applied in a manner consistent with most arguments which may be presented. Support may be gained from it, for a company's position whether it is in the market and wishes to expand, plans to get in, or wishes to protect its existing market share.

Those seeking expansion or entry may argue that the market growth, which appears almost exponential in nature, is capable of supporting many more competitors, and refusal to permit additional suppliers into the market guarantees that the consumers of the service will be denied access to more reasonable rates or innovative additions to the basic service.

These arguments appear valid in theory, but the experience in the United States since the advent of the specialized carrier has not proven to be all that positive. There have been no innovative services developed, nor has there been any significant reductions in subscriber rates for private line services. In many instances, the specialized carrier has sought the assistance of the regulator to have the common carriers apply fully allocated costing techniques in pricing out competitive services. In most competitive situations, recovery of incremental costs plus an adequate return is usually considered to be sound pricing policy. This assistance was sought in spite of the specialized carriers having had the opportunity to choose only the more productive toll routes, from the point of view of traffic generated and cost of provisioning.

When trying to evaluate the effect the CRTC decision to provide for interconnection may have on the communications operating environment and the participants contained therein, it appears that the source of

the figures for analysis is immaterial. The majority of figures used in the analysis of the market were presented by either CNCP or Bell Canada in evidence to the CRTC, and as a result are obviously biased in favor of the firm presenting the argument. The most realistic conclusions we can arrive at, considering the information available, is to identify trends while pointing out the constraining factors of the data.

While CNCP based the majority of their argument on their diminishing share of the competitive market, their absolute revenue from this market was increasing. Table 5 on the following page, derived from the previously referenced 1978 Financial Statisitics, gives the ratio of revenue to investment. CPT has the highest ratio for every year, and CNT is second except for 1972 and 1973. CPT has almost twice the compound rate of growth for this ratio as the highest TCTS member company, while CNT's rate is 1.53 times the rate of the highest TCTS member company. These ratios are derived from total revenues and investment and do not pertain to competitive revenues only. It is interesting to note that CNT was able to maintain the high rate of growth in this ratio in spite of including the figures from its common carrier operations which are located in the most remote and sparsely settled areas of Canada, where one would expect to encounter the lowest levels of operating and provisioning efficiency.

These figures could indicate that either CNCP's falling market share is in line with their relative decrease in investment or that to provide them with the opportunity to generate significantly more revenue with a relatively small incremental investment, would ensure that the revenue/investment ratio would move even further in favor of CNCP.

TABLE 5

RATIO OF OPERATING REVENUE TO
ORIGINAL COST OF PLANT

COMPANY	1972	1973	1974	1975	1976	1977	1978	COMPOUND RATE OF GROWTH (PERCENT)
AGT	.209	.219	.222	.218	.239	.251	.253	3.24
BELL CANADA	.241	.250	.252	.262	.268	.268	.288	3.01
BC TEL	.237	.234	.237	.245	.252	.258	.260	1.56
MTS	.200	.203	.208	.212	.227	.244	.239	3.01
MT & T	.241	.237	.231	.243	.266	.285	.302	3.83
NB TEL	.245	.244	.241	.258	.271	.290	.299	3.37
NFD TEL	.280	.278	.243	.254	.269	.283	.297	0.99
SASK TEL	.232	.234	.234	.237	.251	.243	.257	1.72
ISLAND TEL	.239	.238	.220	.248	.257	.276	.289	3.22
TCTS MEMBERS	.236	.242	.243	.251	.260	.264	.279	2.83
CPT	.294	.304	.327	.358	.375	.424	.448	7.27
CNT	.222	.256	.264	.271	.282	.303	.314	5.95

SOURCE: Financial Statistics on Canadian Telecommunication Common Carriers produced by the Federal Department of Communications - 1978.

The computer communications market is dominated on the consumers side by the larger companies, either in size or geographic scope of operations. These are the firms which will benefit most from interconnection. The benefits could result from reduced rates brought about by increased competition or, as previously mentioned, a CNCP customer with a type 2 connection could bypass the toll network by completing calls through his switchboard to the local switched network. Normal toll charges could be avoided and such revenues would be lost to the common carriers.

It may be argued that these large consumers of computer communications would pass onto the consumers of their products any savings or additional costs which they incur. This would tend to eliminate the need for revenues required for cross-subsidization. This argument may be acceptable if the consumers of these products were the same consumers as those requiring the benefits associated with "life line rates". ⟨1⟩

Table 6 on the following page shows the estimation of revenues gained by CNCP or lost by Bell as estimated by both firms and submitted in evidence to the CRTC hearings. There is naturally a large difference in the figures as each company was trying to strengthen its own argument. Also shown in this table is a linear regression projection of the number of telephones in service for the TCTS member companies through to 1982. The number of telephones was reduced to the number of

⟨1⟩ Life line rates refer to the maximum rate at which low income families would or could retain telephone service.

TABLE 6

CNCP INCREASE IN REVENUE WITH INTERCONNECTION

5 YEAR FORECAST MADE BY CNCP AND BELL

	1978	1979	1980	1981	1982
CNCP FORECAST FOR BELL SERVING AREA		3.2	11.6	24.6	37.2
CNCP FORECAST PRORATED TO TOTAL FOR TCTS MEMBERS SERVING AREA		5.4	19.5	41.3	62.5
BELL FORECAST FOR BELL SERVING AREA	4.9	45.6	103.1	176.1	23.6
BELL FORECAST PRORATED TO TOTAL FOR TCTS MEMBERS SERVING AREA	8.2	76.6	173.2	295.9	396.5
LINEAR REGRESSION PROJECTION OF BELL MAIN STATIONS	5770	6035	6274	6512	6750
LINEAR PROJECTION OF TCTS MEMBER COMPANIES' MAIN STATIONS	8955	9388	9797	10207	10618
REVENUE LOSS PER BELL MAIN STATION					
CNCP FORECAST		.34	1.85	3.78	5.51
BELL FORECAST		4.86	16.43	27.04	34.96
REVENUE LOSS PER TCTS MAIN STATION					
CNCP FORECAST		.58	1.99	4.22	5.89
BELL FORECAST		8.16	17.68	30.20	37.34
REVENUE LOSS PER AGT					
CNCP FORECAST		0.6	2.1	4.4	6.6
BELL FORECAST		8.1	18.3	31.2	41.9
LINEAR REGRESSION PROJECTION OF AGT MAIN STATIONS	656	699	746	793	841
REVENUE LOSS PER AGT MAIN STATION					
CNCP FORECAST		0.86	2.81	5.55	7.84
AGT FORECAST		11.59	24.53	39.34	49.82

main stations or equivalent main stations, ⟨2⟩ by applying the ratio of main stations to telephones as calculated for 1978 using actual figures as shown. The ratio of main plus equivalent main stations to telephones was calculated using the 1978 telephone statistics for all TCTS operating companies, with the exception of BC Tel, who did not submit a figure for main plus equivalent main stations. This ratio was calculated at .6451 and was applied to the telephone figures of Table 6.

Staying with Table 6, we see that by dividing the average revenue change, the average of CNCP and Bell estimates, by the number of stations, an increase of $1.80 per month per station is required to recoup the loss expected in 1982 for each TCTS station. 1982 was chosen because it is expected to take that long for the market to attain a modicom of stability. This increases to $3.11 per month per station if Bell Canada estimates prove to be more realistic.

The actual magnitude of the required increase is not that important; what is important is to recognize that the subscriber's monthly rate for basic local service is susceptible to revenue variations no matter what may cause them.

In this particular instance, the revenue variations resulting from the actions of CNCP may not prove to be beyond the capability of the telephone companies to absorb or lessen the impact on the subscriber, provided all other factors remain constant. The probability of this kind of stability descending on such a volatile industry is very

⟨2⟩ In telecommunication statistics, number of telephones includes all telephones in service in the system, main telephones, extensions, key systems mobiles and virtually anything that remotely resembles a phone. Main stations and equivalent main stations includes only one telephone per number or trunks on a switchboard, extensions and switchboard locals are not included.

low, consequently further discussion is required prior to formulating a conclusion or recommendation.

Referring to Table 7 on the following page, lines 1 through 10 and line 12 are based on dividing the gross additions for the year by the incremental gain in the number of telephones. Lines 11 and 13 were obtained by dividing lines 10 and 12 respectfully by the ratio of stations to telephones. The significance of using stations as opposed to telephones is that the station is the basic non-discretionary unit of service for exchange areas for which a standard tariff is charged. After the basic service is contracted for, discretionary services, such as extensions touch tone calling, call forwarding, and other custom calling features may be requested. The only questionable operation required to produce Table 7 is the division of lines 10 and 12 by the ratio of .6451, for station to telephones, which in fact is true for TCTS members for December 1978. Other than that, the figures are taken from pages 111 and 113 of the previously referred to 1978 Financial Statistics on Canadian Telecommunication Common Carriers. In spite of making this assumption, the actual rise in the cost of investment for each incremental unit of increase was 12.65 percent compounded annually from 1973 through 1978.

The fluctuations of the investment per station between companies may be due to variations in the ratio of exchange plant to toll plant or business communication related investment. The fact remains that all of these investments are necessary to the provision of basic service. Further, the averaging effect inherent in the calculation of line 11 tends to diminish the significance of these variations.

TABLE 7

GROSS CONSTRUCTION EXPENDITURE
PER NET TELEPHONE INCREASE

		1973	1974	1975	1976	1977	1978
1.	AGT	3182	2386	3471	3538	3346	3003
2.	BELL	1539	1882	2188	2182	2983	3087
3.	BC TEL	1659	1984	2559	4298	4595	2859
4.	MTS	1382	1263	1687	2453	2272	3014
5.	MT & T	1650	2186	4735	2761	3213	2415
6.	NB TEL	1323	1945	2385	2795	3869	2399
7.	NEWFOUNDLAND TEL	1219	2135	3280	3292	5334	2458
8.	SASK TEL	1648	2211	2446	2795	1611	2798
9.	ISLAND TEL	1626	2371	2218	2131	2990	1804
10.	TOTAL GROSS ADDS / NET TELEPHONE GROWTH	1633	1953	2446	2669	3045	2963
11.	TOTAL GROSS ADDS / NET STATION GROWTH	2531	3027	3792	4137	4720	4593
LINEAR REGRESSION PROJECTION		1979	1980	1981	1982	1983	1984
12.	COST PER ADDITIONAL TELEPHONE (LINE 10)	3466	3756	4046	4336	4626	4916
13.	COST PER ADDITIONAL STATION (LINE 11)	5373	5822	6272	6721	7171	7620

NOTE: LINES 1-10 AND LINE 12 ARE IN DOLLARS PER NET TELEPHONE GROWTH.
LINES 11 AND 13 ARE IN DOLLARS PER NET STATION GROWTH.

SOURCE: Derived from Appendix 2

This rapid rise in investment takes on even more significance when it is considered that 62 percent of AGT's total capital expenditures in 1978 and 1979 was made in local distribution and switching plant. In the next 5 years 1980 through 1984, expenditures on exchange plant are forecasted to exceed 64 percent of AGT's total capital expenditures.

The reason for emphasizing the rising expenditures required to provide the necessary services, and in focusing on local exchange plant in particular, is to identify the problem which common carriers face in raising capital. This problem is of even greater magnitude for TCTS member companies other than for AGT for two reasons:

1) In 1978 AGT provided 917,000 stations with toll service and 656,000 stations with exchange service. The remaining 261,000 stations were provided with local service by edmonton telephones. This reduced AGT capital requirements significantly, but it is offset somewhat, since AGT has to provide local and toll service in more remote areas than any of the other TCTS members, plus pay annual toll connecting charges to edmonton telephones in excess of 7 million dollars annually.

2) The cost of money to AGT, Sask. Tel. and MTS is less than the rates available to other TCTS member companies by virtue of the guarantees provided by their respective provincial governments.

Returning to Table 7, we see that AGT's position of having to service relatively fewer exchange customers is not all that beneficial. If the revenue losses associated with system interconnection are of the

same magnitude as those expected in Bell territory, it will have even more significance to AGT customers, as there are relatively fewer exchange customers from which to recover the loss. This problem is compounded further in that the compensation which the CRTC has ordered CNCP to pay Bell is in the form of increased rates for rental of local loops. In Alberta, this would mean that at least 28 percent of the revenues so generated would go to 'edmonton telephones'. This percentage is based on the ratio of e.t. stations to the total Alberta stations as of December 1977. The percentage would probably be higher since the majority of the competitive services in Alberta, probably upwards of 80 percent, are generated in the two major centers of Calgary and Edmonton. The split between Edmonton and Calgary would be very close to equal, balancing the toll traffic generated by oil companies in Calgary against that generated by government in Edmonton. This would increase e.t.'s share of the revenue, generated by payments from CNCP operations in Alberta, to 40 percent.

The effect on the residential subscriber of the other provincially owned telephone companies, MTS and Sask. Tel., would be equally harsh, since these companies are dependent on revenues obtained through transitting TCTS calls. The revenues generated by toll traffic between BC Tel and AGT subscribers in the west, and, primarily, Bell subscribers in the east, including overseas traffic, are divided between all companies involved, based on their relative investment in plant required to complete calls. The relative importance of this revenue to these companies may be accentuated by the fact that they derived between 58 and 69 percent of their total revenues from toll traffic from 1973 to 1978. Reference Appendix 2. This is particularly significant for MTS

since Manitoba has only one major city and cannot rely on inter-provincial toll traffic as generated between two major centers such as Calgary - Edmonton or Regina - Saskatoon.

The result of granting interconnection is to provide the opportunity for CNCP to substantially increase its share of the communications market with minimal incremental cost. System interconnection will also provide the means by which the larger businesses, in size or as consumers of communication services, reduce their communication costs directly through slightly lower rates, or indirectly through by-passing the regular message toll facilities of the TCTS member companies. In order to compensate for this loss of revenue, the TCTS member companies will be forced to raise their rates for local exchange service to both residential and business customers alike, with the increased burden being borne by the residential and small business customer.

This shift in the cost burden required to support a public utility for service which, in the present social environment may no longer be classified as discretionary, assumes the characteristics of a regressive form of taxation. The increases required using Bell's forecast, though it may be high, is not beyond the realm of possibility and could push the cost of service for some customers beyond their evaluation of its utility and in some cases beyond their means. The revised price may exceed the "life line rate".

These steps are being taken with no guarantee and with a very low probability that the resulting competition will prove to be a realistic or effective substitute for regulation in the area of discretionary services. The opportunity for increased competition in

the United States has resulted in demands for more, instead of less regulation, as the specialized carriers seek the assistance of the regulators in carving out an even more propitious niche than they could through the introduction of an agressive pricing policy, or innovative services. There is a high probability that CNCP will be content to increase their market share based on improved reliability for priority circuits through increased diversity and by the simple fact that they are an alternative, rather than initiating anything approaching a price war with TCTS member companies.

The increased revenue load being placed on subscribers of basic exchange service, by the effects of market gains achieved by CNCP, will be compounded by the following actions some of which are directly related, and others which are related only in timing and effect.

Increased capital demands are currently being imposed on the common carriers as a result of growth and changes in technology. Line 11 of Table 7 shows the cost to be $2531 per additional station in 1973, increasing to $4593 per additional station in 1978. This represents a compound growth rate of 12.66 percent per annum.

Capital demands are also initiated by governments and regulators requesting improved communications in rural and frontier areas. Requirements for communications in these areas are usually precipitated by resource development. Improved communications are required to conduct business and attract workers. Remoteness and associated high costs are no longer acceptable excuses for service of lower quality than that available in the more populated regions.

The required capital is attainable at reasonable cost only if the telephone companies are able to assure the lenders or investors of their ability to generate an adequate return. The additional costs incurred in obtaining capital, because of erosion of revenues, must also be borne by the consumer.

Competition in terminal interconnection will further erode the revenues of the telephone company. The rental of terminal equipment by the telephone companies has been a source of substantial revenue for many years. The terminal market has always been considered as one of the primary sources of additional revenue when attempting to forestall a rate case, since most of the terminal services are unregulated. The profitability of this venture has increased even further with the advent of the phone store and pre-wired houses.

The movement towards customer owned equipment has merit, but it would almost appear that the telephone company will be forced out of the market after it has made a substantial investment in wiring the necessary flexibility into the residence required to ensure profitability. If the telephone company is forced out of this market it will lose the flexibility in generating additional revenues without incurring the expense of a rate case or raising the cost of basic service.

One further possibility resulting from terminal interconnection must be discussed though no effort will be made to evaluate its impact. Currently there is a federally sponsored investigation underway into the relation between Northern Telecommunications Limited and Bell Canada with a view to identifying any restrictive trade practices which may exist. Though the communication equipment manufacturing in Canada is

restricted to a few large companies, with Northern Telecom being by far the largest, it is a relatively healthly industry when viewed from the level of technology, the export of systems, and the absolute value of research and development carried out in Canada.

Northern Telecommunications provides a substantial portion of the telephones sets and other terminal devices currently used in the systems of Canadian common carriers. If interconnection is ordered, as it has been in the United States, then some form of controls must be imposed to prevent the industry from the type of competition which destroyed the Canadian producers of television and sound systems. The controlling agency must impose the same demanding standards on terminal devices to be connected to the Canadian communication network, as TCTS or the members of the Canadian Telecommunication Carriers Association apply in the design and construction of their own systems. Failure to maintain established standards, and/or restrict imports would subject the existing Canadian manufacturers to unfair competition. Market losses would have to be recouped through increased prices for switching and transmission systems which would undermine their competitive position in world markets. The result of this chain of events would be further cost increases to the Canadian consumer of communication services.

In this chapter we have shown by use of financial indicators that CNCP's income has increased significantly in absolute terms, even though their share of the growing data market has been reduced relative to that of the other common carriers. This increase is more pronounced when compared to that of the common carriers, and proves to be even more dramatic when the increase is indexed to investment.

The investment demands being made on the common carriers by regulators, technological advances and the demand for new and more flexible services, is taxing to the limit, their ability to generate the required capital. This ability is subject to further erosion, the extent of which is unknown, if the other possible changes in the communications operating environment, as discussed in this chapter, do occur.

CHAPTER IX

ECONOMIC THEORY IN TELECOMMUNICATIONS

The economic theory on which the provisioning and maintenance of telecommunication services are based is changing almost as rapidly as the technology employed in providing those services.

Technological advances have provided the main impetus for change along with increased activity in the communication environment by the participants, as shown in Figure 6 on page 73. This change has been aided in part by the increasing activity of academics setting down and justifying their hypothesis of the effect on the utilities, primarily monopolies, of changes to most facets of the operating environment, and on competition as an alternative to regulation for all or selected segments of the telecommunications market.

This desire for change and condemnation of the dominant factors of the existing regulatory process and features of monopolistic utilities has been summarized rather succinctly in the 11 rules for regulators suggested by Hendrick Houthakker in his article titled "Economic Aspects of Regulation ⟨1⟩ . His rules appear to be guidelines for further economic research rather than rules for regulators in that they express the academics' penchant for a totally free market without addressing the problems associated with application of these theories.

Academics, active in this area, have been motivated to perform these economic analyses by their belief in the free market system with a

⟨1⟩ Hendrick Houthakker, "Economic Aspects of Regulation", <u>Deregulating American Industry</u>, eds. Donald L. Martin and Warren F. Schwartz (Toronto: D.C. Heath & Company, 1977), p. 17.

minimum of government interference, and a pervasive belief that regulation is both inefficient and ineffective. These positions have been readily supported by the Specialized Common Carriers (SCC's) and those business entities most likely to benefit from increased competition in the toll segment of the telecommunications market. The study by Averch and Johnson ⟨2⟩ on the propensity for utilities in a monopolistic environment to over-invest in an effort to maximize profits has formed the basis for most studies dealing with ineffectiveness.

The other major aspect of ineffectiveness is the inability of the common carrier to directly associate costs with sources of income. This failure precludes the proper evaluation by the regulator of the pricing strategies proposed by the carrier, with the result that the cost allocations become quite subjective or the pricing philosophy reverts back to the value of service concept.

There are two major considerations to the efficiency aspect of regulation. The first one is the efficiency of the adversary process currently in use. This question refers primarily to the costs incurred by the participants during the hearings. Most of these costs are eventually passed on to the consumer of the services through an assessment process whereby the carrier is held responsible for a portion of the costs incurred by the intervenors, as apportioned by the regulator. The length and complexity of the hearings has increased these costs to the point where they contribute significantly to operating costs of the carrier. Significant costs are also incurred by

⟨2⟩ Averch and Johnson, loc. cit.

the carrier as a result of permanent staff involved in regulatory requirements and associated accounting activities.

The second question deals with the efficient allocation of resources in a regulated environment as opposed to one of competition. ⟨3⟩ This is a much broader question in that it must deal with economies of scale associated with the provisioning and operating of a communications network, the pricing mechanism and the effects of regulatory delays in establishing prices.

In a study conducted by George P. Mandanis, ⟨4⟩ he reached the following conclusions:

1) The provisioning cost per circuit mile of terrestial toll facilities varies:
   a) inversely with the distance covered;
   b) inversely with the number of circuits in the cross section; and
   c) directly with icreasing band width or data capability of each circuit.
2) The operating costs per circuit mile of terrestial toll facilities vary:
   a) inversely with the distance covered;
   b) inversely with the number of circuits in the cross section;

⟨3⟩ Richard A. Posner, "Taxation by Regulation", The Bell Journal of Economics and Management Science, II (Spring, 1971).

⟨4⟩ George P. Mandanis, "An Emperical Analysis of Economics of Scale and Specializations in Communications", New Dimensions in Public Utilities Pricing, ed. Harry M. Trebing (East Lansing: Michigan State University Public Utilities Studies, 1976), pp. 333-341.

c) directly with increasing band width or data capability of each circuit; and

d) inversely with the percentage fill in the cross section.

These relationships are subject to the effects of variations in topography and climatic conditions, which could increase or reduce the costs relative to the averages on which the conclusions are based.

The conclusions support the claim of the specialized carriers that they would be able to substantially reduce the rates charged by the franchised carriers, simply by concentrating on the high density toll routes. This advantage could be further enhanced by using the most advanced technology and/or routing via satellites, which tend to be distance insensitive, where the service under construction is compatible with satellite parameters. These conclusions also support the franchised carrier's contention that under the existing conditions of pricing and obligation to connect all customers seeking service, the flexibility in choosing rates and routes places the specialized carriers in a very advantageous position.

The pricing mechanism, as explained in Chapter V and currently in use by the franchised carriers, must be allowed to change if the franchised carriers are to satisfactorily compete with the specialized carriers. The Hi-Lo rates referred to on page 44 differ substantially from the current rate schedules both in substance and the philosophy on which they are based.

The franchised carriers, in proposing the Hi-Lo pricing mechanism, are attempting to introduce marginal cost pricing on those routes and for those services which are being subjected to competition.

This pricing policy is contrary to the following concepts which were developed over many years of regulatory action:

- non-discriminatory pricing;
- rate averaging; and
- cross-subsidization of exchange service by toll revenues.

Introduction of this type of pricing mechanism has initiated actions by the SCC's to have the regulators declare the Hi-Lo prices predatory or retaliatory in nature, and ensure the common carrier use fully distributed costing procedures at all times. This type of request was upheld by the FCC in a ruling on Docket 19919, dealing with Hi-Lo rates, on January 16, 1976. AT&T was the common carrier and MCI was the intervening specialized carrier. ⟨5⟩

Marginal pricing techniques for utilities confronted with competition were discussed and supported by William G. Shepherd. ⟨6⟩ He maintains that the reduction in demand due to competition causes the demand curves to intersect the marginal cost curves at a point of much lower cost due to the plant being already in place. He argues that until the demand increases to the point where additional facilities are required, the utility is justified in basing its rates on the much lower marginal cost.

Shepherd also raises the question of equity as it pertains to social responsibility. He does not pretend to offer any solutions to this question, but he does make the point that economic efficiency should not be the only criterion in the establishment of a pricing

⟨5⟩ Owen and Braeutigam, op. cit., p. 229.

⟨6⟩ Shepherd, op. cit., p. 135.

policy. He went on to state in the summary of this same article that economics, demand and social factors are extremely complex and interdependent, and consequently caution should be exercised in timing and extent of change implemented, in order to avoid irreparable harm to the system.

This fear of the unknown is valid and is based on the premise that the existing system, though not equitable nor the epitome of efficiency, does work well. The problem lies in determining where improvements may be made and hopefully, the extent to which changes should be allowed to occur before the vested interests in the revised market become so large as to preclude reverting back to a more stable or efficient point of operation. Obviously, no point in any developing market is that rigid, but the associated cost of re-establishing a stable base of operation could be prohibitive.

In the United States, the FCC has already taken the introduction of competition past the point which most of the available literature recommended. They did this when they allowed MCI to provide message toll service as opposed to being restricted to private line services. Where studies such as that conducted by Harry M. Trebing and William H. Melody on Entry Conditions in Telecommunications ⟨7⟩ viewed the effect which specialized carriers would have on ATT as insignificant, they were unaware that the message toll market would soon be opened up to competition.

⟨7⟩ Harry M. Trebing and William H. Melody, "Entry Conditions in Telecommunications", Regulation and Entry, eds. Michael Klass and William G. Shepherd (East Lansing: Michigan State University Public Utilities Papers, 1976), pp. 95-96.

When this type of competition is sanctioned in Canada, the yet-to-be-identified ramifications will be more intense due to the greater reliance on toll revenues. ⟨8⟩ Besides the expected loss of revenue and the problems associated with this, the publicly held companies will experience financing problems. The main problem will be the raising of capital while facing increased uncertainty in the future earning stream. The need for capital will not be significantly reduced because the exchange areas, which consume about 65 percent of construction capital, ⟨9⟩ will not be subject to competition due to the low return on invested capital.

The final aspect of economic theory pertaining to system interconnection to be considered in this thesis is the effect of regulatory delay in pricing decisions. If the regulatory agency is not inclined to consider interim rates, and the trend is in that direction as the burden of proof lies with the firm seeking rate relief, delays in setting rates may cause many financial problems.

The basis of this financial problem is rooted in the fact that this is a capital intensive industry and the demand for capital is increasing, with rising labor rates and increased demand for new services, which is being stimulated by technological advances and competitive posturing. The difficulties with increasing demand are

⟨8⟩ See Table 3 on page 54 of this thesis.

⟨9⟩ This percentage is based on AGT's forecasted construction budget over the next 4 years. When considering this, the reader should bear in mind that AGt provides toll service to 100 percent of the telephone subscribers in the province while providing exchange service to only 70 percent of the subscribers.

compounded by reduced generation of capital and erosion of its usefulness, over time, due to inflation.

These problems are further aggravated by the carrier's diminishing ability to generate funds, due to the regulatory delay, and the uncertainty surrounding the extent and effect of competition. These conditions in turn result in higher costs for both equity and debt capital as both these markets will react to the increasing uncertainty of the income stream.

CHAPTER X

CONCLUSION and RECOMMENDATIONS

The events that shaped the telecommunications environment leading up to the situation as described in Chapters 8 and 9 did not happen by chance. Nor were they the result of unilateral action by any one participant. More importantly, the previously referenced events did not develop as the natural outcome of the implementation of a well conceived communication policy developed by the federal government. The events did occur as the result of decisions made, by the various participants, based primarily on expediency and self interest.

No single participant is to blame for this situation, nor is any participant free of responsibility for the series of events leading to the current situation. Therefore, no one or two participants should be made to bear the consequences of the recent requests for change.

The efficiencies and automatic controls alluded to in most studies on operating in a competitive environment simply do not exist in this situation or in most situations where the cost of entry is high or only selected segments of the total market are open to competition. This is particularly true when the competitive market segments are chosen by the competitors and only franchised carriers are obliged to provide service to all who request it, virtually without exception.

Therefore the conclusion of this study is that the CRTC should not have granted CNCP system interconnection with Bell Canada.

This is not to say that the status quo should be maintained, or that CNCP should never be granted interconnection. What is being said is that a comprehensive review of the total communications environment

must be undertaken in order to prevent a series of unassociated decisions being made, in an atmosphere encouraging change for the sake of change, which in total would seriously threaten the common carriers ability to function. It is understood that these decisions are not irrevocable, but because of the magnitude of the expected investment by specialized carriers, the decisions would be most difficult to modify. The expenditure in time and money required to perpetrate significant modification may make any changes ineffective.

Solutions to the telecommunication problems must begin with resolution of the jurisdictional dispute between the federal and provincial governments. The United States model of federal jurisdiction over intraprovincial communication would be workable. Federal jurisdiction would be maintained in the assignment of frequencies in the radio spectrum for microwave systems, one of the few areas in which there appears to have been some thought and planning involved.

The next step would be the joint development, with federal and provincial participation, of a national communications policy. The ability to communicate effectively, efficiently, and with a high level of reliability and confidentialty, will be a major factor in the economic and cultural viability of this or any other nation. It follows that the next step would be the formulation of the provincial communication policies. The provincial policies would be designed to augment the national policy, and satisfy the various nuances in operating and cultural environments peculiar to each province.

Without having the benefit of the communication policies of the federal and provincial governments, there are two things which the

common carriers should do. The carriers must move towards a more cost based pricing policy. The biggest impetus for the influx of competitors has been the supernormal profits available in selected segments of the market. The degree of cross-subsidization maintained, or the maximum monthly rate for the provision of basic residential exchange service, should be specified in the provincial communication policy.

From this point the common carriers will be able to determine the feasibility of implementing a usage sensitive pricing system for local exchange service. Implementation of this type of charging would allow the consumer the option of maintaining a basic service at a minimum rate. Those consumers who use the system extensively and are thus responsible for the larger share of the costs, would be billed accordingly. This type of billing system could be applied to extended flat rate service charging, thus turning around a system, introduced for political expediency.

In order to base the price of a service on the costs incurred in providing the service, a major renovation of the system of accounts is necessary. This is the second item which could be done without the benefit of government policy.

The existing system of accounts was developed in the early years of the industry when little or no consideration was given to cost causation or the possibility of competitive services. The complexity associated with the size or the scope and variations in conditions under which services are offered were not considered in the parameters under which the system of accounts was developed. Within this system of accounts, costs associated with particular services may be developed only through the use of an arbitrary allocation process.

The new system of accounts should provide the management of the telephone companies more pertinent information on which to make decisions. The quality of the information and subsequent decisions must be high in order to provide an opportunity to survive in a industry subject to both the pressures and opportunity for change.

Possible improvement in the quality of information would also assist the regulator in completing his almost impossible task. To sit outside of such a complex operation as a telephone company, operating in an ever changing environment, and be forced to make meaningful decisions based on incomplete information is impossible.

The regulators problems are further compounded by the lack of government policy and positive cooperation by the telephone companies. The telephone companies have traditionally adopted a philosophy of reaction as opposed to one of positive action. The telephone companies tend to wait for all participants in the operating environment to establish a position, and then they react to each participant's position independently. Positive action would involve establishing a position on each issue, and then supporting those positions with submissions to the regulators, offering information and assistance in interpreting the information, and evaluating the effect of the company's position on the issue. AT & T appear to be adopting this philosophy in its recent submissions in the communication hearings before the United States Congress. Paul H. Henson of United Telecommunications Incorporated in the United States presented a position paper to a United States Senate Committee in March of 1977. His paper agreed with many of the positions presented in this thesis and he concluded with an alternative that could be applied to the Canadian communication problem.

Mr. Hensen proposed that efficiencies of scale were to be found in the provisioning of facilities, and that duplication of any portions of these facilities would only result in wasted capital and additional cost to the consumer. He therefore recommended, consistent with past recommendations by common carriers, that the franchised operating telephone company be the sole provider of communication facilities within the franchised area.

From that point on, his recommendation deviated from past telephone company proposals, in that he recognized the telephone companies were not experts in every facet of communication service. Where a particular expertise, experience or special interest did reside outside of the telephone company, the company or companies possessing that special skill should be allowed to provide the service.

You would then end up with the telephone company providing the facilities and basic service and special service companies renting the frequency spectrum or facilities required to provide the service for which they have proven capability. When the local network reaches the stage of wide band switching capability, as anticipated with the development of fibre optics, cable television companies would also lease facilities or spectrum from the telephone company.

The conclusion and the recommendations are based on the arguments presented in this thesis and could be subject to change based on a more rigorous economic and market analysis. What is recognized in this thesis is that the Canadian network provides reasonably efficient services at prices which are the second lowest in the world, while at the same time it remains responsive to changing technology and requests

for new and innovative services. In reaching the conclusion of recommending that CNCP not be granted system interconnection we recognize the inconclusiveness of the CNCP argument and the existence of the many other threats to the Canadian communications operating environment which must be considered in concert with the CNCP application.

CHAPTER XI

ALTERNATIVE MARKET CONFIGURATIONS

The recommendation of Chapter X is for a course of action rather than the establishment of a particular market scenario. In adopting this approach, we recognize the volatility of a market involving such dynamic participants. With this in mind, we will describe some possible configurations which may develop, and the impact which these may have on the franchised common carrier.

The alternative configurations which we will develop will focus on the Alberta segment of the Canadian communications market. The primary reason for reducing the area of concern in this manner is that the Public Utilities Board (PUB) of Alberta has published their positions on most of the pertinent issues in a report titled "Telecommunications Inquiry, Report Ne E80111", dated September 1, 1980. This Inquiry was initiated by Orders in Council of the Alberta Government dated December 6, 1978 and February 27, 1979, and resulted in the establishment of probable guidelines for the development of communications within Alberta. The positions taken by the PUB represent a recommendation to the Alberta Government and should not be construed as a firm policy statement. In some instances, the position preferred by the PUB would require enactment of ammending legislation or it may fall into the area of jurisdictional dispute between the Federal and Provincial governments.

The first possibility which we will discuss is the proliferation of communication suppliers. Firms similar to the specialized common carriers (SCC), referred to on page 38 of this

thesis, will probably initiate actions, after the interconnection sought by CNCP has been finalized, designed to allow them to participate in all or most regulatory jurisdictions in Canada.

Large, well established firms from the United States such as Southern Pacific Communications Company and local firms such as TAS Communications, both of which participated in the Telecommunications Inquiry conducted by the Alberta PUB, are seeking access/more access to the network in order to establish/improve their competitive position. Assuming that the Alberta PUB will pursue their stated objective of increasing competition in as many segments of the communication market as they designate as competitive, ⟨1⟩ they will, upon exercising their regulatory power, ⟨2⟩ be hard pressed to restrict entry into the carrier field to only AGT and CNCP.

Southern Pacific and TAS are representative of two distinct segments of the communications market. Southern Pacific operates primarily in the specialized common carrier segment while TAS provides telephone answering and paging services. Initially, TAS will probably

⟨1⟩ On page 37 of the Telecommunications Inquiry Report, the PUB states their position on competition as follows: The Board recommends that Non-Basic Telecommunications Services be regarded as competitive service offerings. Accordingly, the Board recommends that there be no market entry regulation respecting providers of Non-Basic Telecommunications Services.

⟨2⟩ On page 39 of the Telecommunications Inquiry Report, the PUB states their desire to control provision of facilities for competitive services as follows: The Board considers that Non-Basic Telecommunication Services be regulated by the Board with respect to the construction or extension of any transmission/distribution network associated with these services.

seek to extend their paging services from a series of paging areas to a province-wide service, through automatic access on a selective basis to the AGT toll network.

As an SCC, Southern Pacific will probably seek dial-up access by consumers, to Southern Pacific facilities yet to be constructed. Southern Pacific and similar carriers will, in all probability, request the PUB in Alberta and the appropriate regulators in other jurisdictions, to order the franchised common carriers to make toll facilities available to them. These facilities would be used to extend the services of the SCC's to customers beyond the reach of their established facilities.

Competition in the transmission or special service network will be further expanded as the Value Added Networks (VAN's) move up from the United States or develop independently in Canada. These carriers operate by leasing facilities from the common carriers, enhancing them in some manner to form a specialized network, through which they provide customized services to their subscribers. This type of service is prohibited by the regulations contained in the tariffs of most Canadian common carriers, therefore the carriers will have to receive directives for change from their regulators, or the regulators will request the legislative body, to which they are responsible, to amend the appropriate legislation.

These competitors would pose a threat to AGT's special service or competitive toll revenues of 44 million dollars in 1980. The magnitude of this threat is put into perspective by comparing the 44 million dollars of competitive toll revenues to an expected net profit

of 25 million dollars. This threat would appear even more significant if the incremental cost of providing such services were completely identifiable.

The SCC's and VAN's would create further economic problems for the carriers in the forecasting and provisioning areas. If these competitors are able to request access to the carriers' facilities, and the regulators insist on the availability of such facilities basically on demand, the carriers will be forced to over-provision. This problem is compounded by greater uncertainty introduced into forecasting the carriers' own requirements and the lead time required for the provisioning process.

The revenue reductions which the franchised common carriers would actually experience would depend in part on the structure and the manner of conducting business prescribed for the carrier by its regulating agency. If the regulators were to take the position that all distinguishable services be offered by individual, arms-length companies, increased overhead would compound the effect of revenue reduction.

In the previously referenced Telecommunications Inquiry, the Alberta PUB's position was that AGT would not be required to establish arms-length subsidiaries as long as they could prove, by means of a contribution test, that each competitive service or a related group of competitive services were not being subsidized by revenues derived from basic services. In the appendixes of the report, the PUB classified most of the existing communication services as follows: Basic Telephone Services, Appendix 9; Basic Cable Television Services, Appendix 10; Non-Basic Telecommunication Services, Appendix 11.

If this configuration were maintained, the franchised common carriers within the TCTS consortium could continue to provide services at the present level with little change in the pricing structure. The degree of rate restructuring would vary with the economic realities of the particular operating area.

The Alberta PUB, consistent with their stated preference for increased competition, further recommended in the report that the communications terminal market segment be opened for competition. Loss of associated revenues in this market would further compound the effect on the franchised common carriers of the previously discussed system interconnection. This is particularly true since the revenue loss is in the exchange market area which, in Canada in particular, is heavily cross-subsidized from toll revenues.

The degree of loss experienced by the carriers will vary in accordance with the degree of competition allowed by the regulator and the competitive posture which the regulator permits the carrier to assume. The ability to assess the impact of competition in this segment will be restricted by the existing system of accounts. This restriction will also limit the carriers' ability to react to competitive pressures.

The most damaging configuration from the carriers' point of view involves the reclassification of existing basic serevices to the competitive segment. This is particularly true of message toll service which generates the bulk of the revenues required for cross-subsidization of exchange service.

An example of this type of competitor is MCI Telecommunications (MCI) of Washington, D.C. MCI, which operates in the United States offers the equivalent of message toll service. They initially offered

services similar to private line services by means of microwave systems connecting larger cities in the more densely populated areas. Initially, these systems were built to connect centers with known intercity calling patterns, but were designed for integration into the larger system when both capital and demand for service warranted such a move.

MCI developed their range of private line services to the point where, considering the entry of other carriers into the field, the development of VAN type communication service companies and AT&T's positive response to the growth of competition, they felt that the most positive move for them was to offer message toll service. After having applied for and being refused by AT&T unlimited access to the local switched network, they proceeded with an antitrust action against AT&T. They were successful in this action and are now offering message toll service. ⟨3⟩

In an interview which appeared in the October 25, 1980 issue of the Financial Post, MCI spokesman Gary Tobin made the following comments about MCI's progress to date:

- They currently offer message toll service to 80 densely populated areas in the United States which includes 3,500 cities.
- There are plans for expansion into Florida and the Pacific Northwest next year and they are considering expansion into Mexico and Canada in the near future.

⟨3⟩ Owen & Braeutigam, op. cit., p. 229.

- MCI increased their revenues from 7 million dollars in 1975 to 144 million dollars in 1979.
- They expect to have access to 90 percent of the population in the United States in a few years but currently have no plans to access the final 10 percent because they estimate the cost would equal the cost of reaching the preceeding 25 percent.
- In the higher density routes, MCI has been able to undercut AT&T rates by as much as 60 percent.

If this type of competition were permitted in Canada, the franchised common carriers would be forced into an even more difficult position given their greater reliance on toll revenues as a result of the relatively higher rates charged for message toll services.

Though the Canadian market is much smaller and, with the exception of a line between Montreal and Toronto, the densities of the eastern seaboard of the United States do not exist, super normal profits of sufficient magnitude do exist in the cross-sections between the major Canadian centers which are attractive to this type of competitor.

If Canadian regulators were to allow this type of competition to develop in Canada, the Canadian telecommunications industry would be subjected to an almost total reconfiguration. The dependency of the franchised carriers on toll revenues could no longer be maintained, and a total restructuring of the rate schedule would have to be undertaken if the current level of service is to be retained in areas of low population densities or difficult access.

Assuming the regulators and/or their governing body, while responding to the pressures for increased competition, would not

tolerate a reduction in service levels for basic telecommunication services, alternate sources of revenues would have to be found. The most basic decision which must be made is determination of the source of the revenues. Should they be generated within the industry in the form of rate restructuring or should those suscribers or geographical areas requiring assistance have direct access to public funds.

Since direct taxes are usually the most unpalatable to the taxpayer and subsequently the politician, we will concentrate our efforts on a review of the alternatives associated with generating the revenues within the industry. The alternatives considered will not be exhaustive but should be indicative of the type of options available within the industry.

The most obvious alternative would be to set the connection fees high enough to compensate for the lost revenue. This alternative would have the synergetic effect of maintaining and protecting the revenues of the telephone companies through generation of increased revenue and reduction in the competitive advantage expected by the SCC's or VAN's.

The second alternative would be to generate the required revenues through increased exchange rates charged to business subscribers. This alternative would tend to recoup the revenues from the primary source from which the revenue losses would be incurred. It does nothing towards allocating costs on a causal basis and tends to aggravate the consumer segment which supported competition in the first instance.

The third and fourth alternatives involve raising the basic rates for exchange service for both business and residential service,

thus increasing the revenue from exchange services. The third alternative would retain the value of service and rate averaging concepts and would reduce the disparity between costs and revenue related to exchange service in total. It would retain the arbitrary nature of cost allocation and considering the dependency of Canadian telephone companies on toll revenues (see pages 1 and 2 of Appendix 6), increase the residential rate to the point where low income families and pensioners may no longer be able to afford service.

The fourth alternative may offer a viable solution to the problem of lost revenue and of some subscribers being unable to afford basic service required for emergent situations. This alternative involves the application of a usage sensitive pricing scheme.

The most common method of applying usage sensitive pricing is the application of a reduced monthly charge which allows for the placing of a fixed number of calls within a designated calling area. Increases in the number of calls, expansion of the calling area weighted by the time of day the calls are made results in increased charges. The first logical step in implementing a usage sensitive system would be the elimination of extended flat rate calling schemes. ⟨4⟩

Another billing method involves the assignment of message units to the various parameters which contribute to the cost of provisioning, such as frequency of calls, duration of the call, distance and the time at which the call is made. The customer is then charged for the number of message units which he consumes during the month. ⟨5⟩

⟨4⟩ See page 31 of this thesis.

⟨5⟩ James G. Cosgrove and Peter B. Linhart, "Customer Choices Under Local Measured Telephone Service", Public Utilities Fortnightly, CIV (August 30, 1979), pp. 27-31.

Usage sensitive pricing is not the ultimate in the allocation of costs, since only about 15-25 percent of the costs incurred in providing service are usage sensitive, and even this is dependent on the particular circumstances. For small offices, where the initial size or the incremental size of additions far exceeds the capacity requirement for the number of customers being served, there are virtually no usage sensitive costs. ⟨6⟩ The virtual qualification also applies to smaller offices where the cost for the central processor of the switching machine far exceeds the cost of the actual switching portion of the machine. The dichotomy faced by the carrier is that step-by-step switching, which is more reflective of the usage sensitivity concept in its usage and provisioning, is not capable of generating the information required for usage sensitive pricing without the addition of expensive peripheral equipment. ⟨7⟩ Further, the outside plant portion of the cost of provisioning for exchange service is also insensitive to usage.

On the positive side of the usage sensitive pricing ledger, the computer controlled switching machines, both analogue and digital, are capable of generating the required billing information. Also, the usage sensitive pricing concept is a more reasonable method of allocating charges than the value of service concept currently in use.

⟨6⟩ Leland W. Schmidt, "Comment" (on Raymond M. Alden), New Dimensions in Public Utilities Pricing, ed. Harry M. Trebing (East Lansing: Michigan State University Public Utilities Studies, 1976), p. 323.

⟨7⟩ American Telephone & Telegraph estimate the cost for measuring equipment to be $5.00 per line in electronic offices. Lawrence Garfinkel and Peter B. Linhart, "The Transition to Local Measured Telephone Service", Public Utilities Fortnightly, CIV (August 16, 1979), p. 20.

Usage sensitive pricing appears to have many favorable characteristics but it is not capable of establishing a causal relationship between cost and price and the carrier would incur significant costs for implementation and maintenance. Usage sensitive pricing does not warrant an all-out implementation program, as suggested by Raymond M. Alden ⟨8⟩ but it should be the subject of an extensive cost benefit study to determine if and when it should be introduced. Without the aid of these studies, we would suggest that there is a minimum exchange size below which USP should not be considered, and the number of billing options from which the customer may choose should not be so large as to cause excessive expense in gathering and processing the billing information.

The alternatives presented are responses to the requirement for maintaining existing levels of basic service while experiencing significant reductions in toll revenue.

The first alternative is not too realistic in that it tends to defeat the purpose for which competition was introduced.

The second alternative in placing the responsibility on business enterprises is in effect placing the costs of providing unprofitable basic services on the customers of the businesses. This constitutes one of the more progressive forms of taxation. This alternative is also counterproductive with respect to one of the original intentions of introducing competition into communication services, supplying an incentive for the business enterprise to support the new communication suppliers.

⟨8⟩ Alden, <u>op. cit.</u>, p. 302.

The third alternative allocates the cost to those groups which cause them to be incurred, with the fourth alternative allocating the charges in a more reasonable and equitable manner on an individual basis.

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APPENDIX NOTES

The calculation of revenues from the market segments, as identified by CNCP, was based on the following source documents. The initial submission by CNCP to the CRTC which identified the total revenue for each market segment and CNCP's share of that market. The year end Operating Revenue Reports for AGT for the years 1973 through 1978 and the Financial Statistics on Canadian Common Carriers as produced by the Government of Canada, Department of Communications for the years 1974, 1976 and 1978. The latter source was used most extensively throughout this study.

Table 113.1.2 Toll revenue and Table 113.1.5 Total operating revenue of the Financial Statistics were the source documents for the first 6 lines on each page of Appendix 2. The exchange revenue is the total revenue minus the toll revenue. The toll and exchange revenues for the other TCTS member companies were then indexed to AGT's revenues.

The Operating Revenue Reports for AGT were used to develop Appendix 3. The totals for each market segment for the years other than 1976 were indexed to 1976.

Page 4 of Appendix 4 was derived by applying the indexes from page 4 of Appendix 2 to AGT's 1976 revenues for each market segment as shown in Appendix 3. The difference between the revenue totals for each market segment, attributable to the common carriers, and those developed in Appendix 5 were prorated between BC Tel and Bell Canada on the basis of revenues for each company shown on Appendix 2. This procedure is based on two major assumptions:

1) The market size and share identified by CNCP are correct.

2) The communication activity expected in the operating areas of BC Tel and Bell Canada warrants, the assignment of the surplus to these two companies.

The remaining pages in Appendix 3 were derived using 1976 as the base year and assuming that the growth percentages experienced by the other TCTS member companies, over the years 1973 to 1978, was the same as that experienced by AGT.

APPENDIX 1

SWITCHING HIERARCHY

The switching offices in the Canadian Telephone Network fall into 5 distinct classifications, 4 of which are toll classifications. Starting at the bottom of the hierarchy, they are as follows:

Class 5 This office is the local switching office which is capable of connecting the customer to other customers on the same switch, to customers connected to other class 5 offices in the same exchange area or to the toll network.

Class 4 This office is called a toll office and is the first level of toll switching. This office has the capability of interconnecting class 5 offices which are connected to it, interconnecting to another class 4 office or to a class 3 or 2 office depending on the routing options designed into it.

Class 3 This office is referred to as a primary center and its principle function is the switching of calls between toll offices and is normally the source of most of the high usage trunk groups.

Class 2 This office is called a Sectional center and normally there is only one of these offices per area code.

Class 1 Regional center. There are only two such offices in Canada, Montreal and Regina.

The office hierarchy was established to facilitate administration traffic flow, supervision and economic provisioning patterns.

Combination of offices such as 4 and 5 were not uncommon but as toll centers have become larger and fewer in number it is becoming quite rare to find toll and local switching being handled on the same switch. Combinations of various classes of toll offices on the same switch is still common.

On page 108 of this appendix is a schematic diagram of how the various offices are interconnected in the hierarchy scheme, which is a North American standard. Note the offices on the left are classified by name while those on the right are given the corresponding class number and also that each office is designated alphabetically for future use in the narrative description.

We will trace through a few simple calls in order to show how the network operates and what options are available.

The first point to consider is the numbering scheme, which again, consistent with the hierarchy scheme is a North American standard. Each customer is assigned a seven digit code the first three digits of which are referred to as the NNX code and designate which machine or 10,000 number group he belongs to in a certain office. The X can be any number from 0 - 9 while the N excludes 0, 1 and sometimes 9. The NNX code cannot be repeated within a Numbering Plan Area (NPA). The flexibility and number usage efficiency is very dependent on the types of switching machines in use in a particular region. The electronically controlled machines with the inherent translation capability and flexibility in the number of digits forwarded allows for maximum utilization of NNX codes under the constraint of one NNX for each office or 10,000 line groups.

The area code, a distinct 3 digit code, identifies each numbering plan area. In this area the local telephone company is responsible for number administration but must coordinate on a North Amercian basis all changes or additions to the numbering plan, as the NNX code is used for both routing and billing of all toll calls. The area served by an area code varies inversely to the population density and the number of distinct or separate communities, within the area, which require their own end office. The importance of the last factor will diminish as digital switches with remote switching units will reduce the need for separate switching offices with individual (NNX's) in many of the smaller centers.

If customer B1 wishes to call customer B2 he dials the NNX associated with the office, followed by the 4 digit code which designates customer B2. The local switch in office B then connects customer B1, to B2.

If customer B1 wishes to call customer C1, then customer B1 dials 0 or 1 in order to access the toll network, then depending on the type of toll service requested, either B1 or the operator dials C1's NNX plus a 4 digit code and a talk path is established through office B to G to C to customer C1.

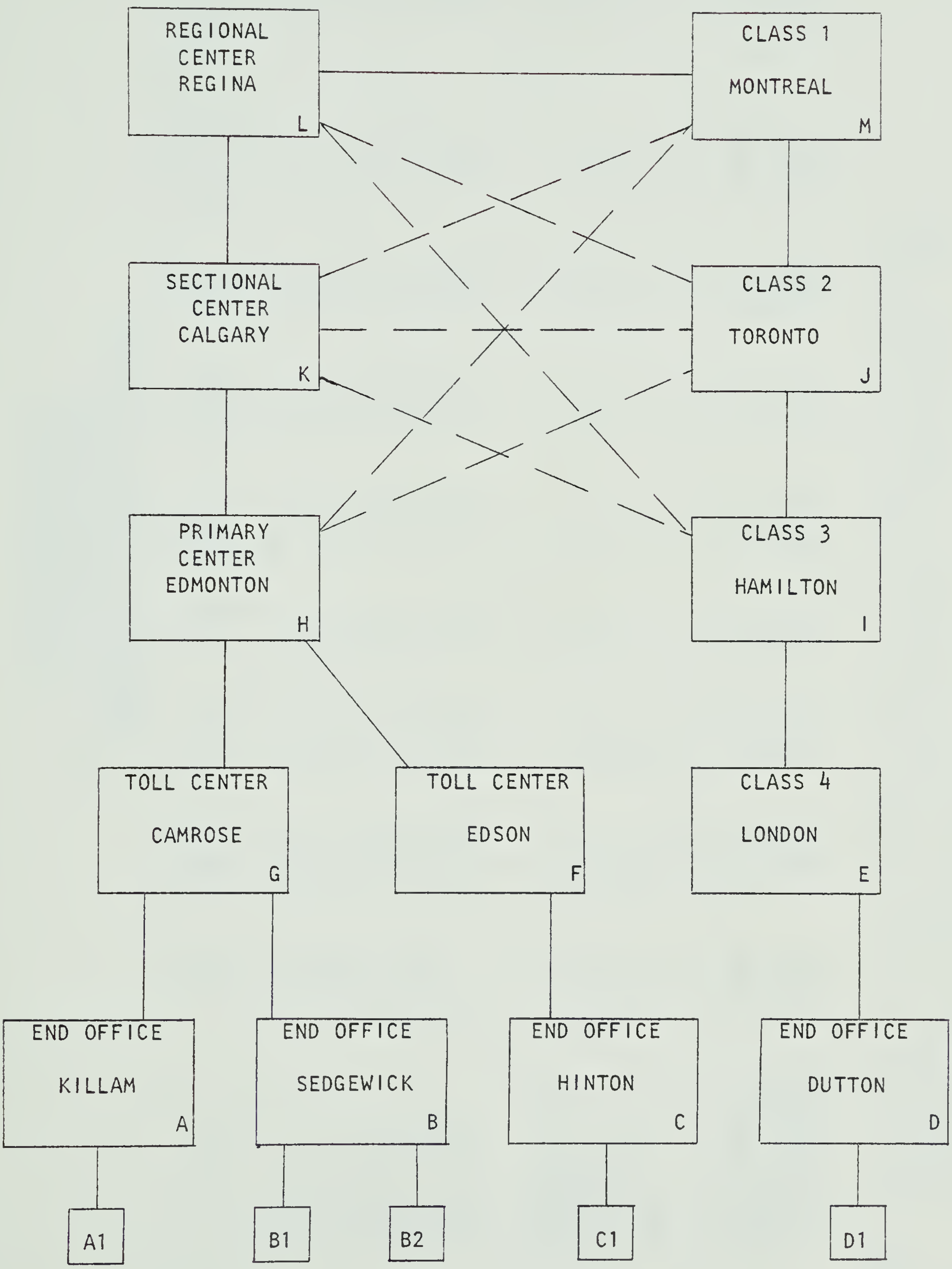
If B wished to contact A, the call would likely be established through offices B, G, H, F, A, or if a trunk group existed between G & F, then H could be eliminated. The existence of a trunk group between G and F is dependent on the calling patterns between the end offices served by G and F and the geography and distances between G and F and G, H and F.

If C called D, then the routing options become quite numerous and again are dependent on similar criteria to that discussed in the preceeding paragraph. If the offices involved are in fact those given as examples then it would be highly unlikely that high usage groups exist between offices F and M, F and I, H and E or even H and I. Trunk groups most likely exist for the other inter-office routes shown.

Provided the preceeding assumptions are true the initial part of the route C-F-H and the final portion I-E-D are fixed and completion of the call is dependent on trunks being available in these groups. Once the call had progressed to H, the switch at H would look for a free trunk from H to J, if one were not available it would look for trunks H-K-J proceeding through all possible combinations such as H-K-M-J or H-L-M-J until a path is established or a trunk busy signal is returned to C1. Such an exhaustive search normally takes no more than a few seconds.

FIGURE 8

SWITCHING HIERARCHY



OPERATING STATISTICS

TCTS MEMBER COMPANIES

INVESTMENT and REVENUES (000,000)

LINE	1973	AGT	BELL	BC TEL	MTS	MT & T	NB TEL	NFD	SASK TEL	ISLAND TEL	TOTAL
1	TOTAL REV.	162.4	1275.4	258.9	71.5	62.2	55.4	26.2	42.6	6.5	1961.1
2	% TOLL	67.1	43.3	51.3	58.0	50.2	56.0	54.2	63.6	47.7	.480
3	TOLL REV.	109.0	552.1	132.7	41.5	31.2	31.0	14.2	27.1	3.1	941.9
4	INDEX AGT	1	5.065	1.217	.381	.286	.284	.13	.249	.028	9.092
5	EXCH. REV.	53.4	723.3	126.2	30.0	31.0	24.4	12.0	15.5	3.4	1019.2
6	INDEX AGT	1	13.545	2.363	.562	.581	.457	.225	.290	.064	19.633
7	COMPETITIVE										
8	REVENUE	9.5	60.4	14.8	3.8	3.4	2.6	1.5	3.8	.6	100.4
9	EXCHANGE	1.9	20.1	3.9	.9	1.1	.7	.4	.9	.1	30.0
10	TOLL	7.6	40.3	10.9	2.9	2.3	1.9	1.1	2.9	.5	70.4
11	PLANT INV.	740.1	5102	1105.2	352.5	262.8	227.2	94.2	283.6	27.5	8195.1
12	NO. TEL (000)	645	7102	1282	488	350	283	123	367	42	10682
13	NO. EMPLOYEES	7369	43033	13128	4286	3152	2483	1124	2695	258	77528

SOURCE: Lines 1-6 and 11-13 from Financial Statistics on Canadian Telecommunication Common Carriers Produced by the federal Department of Communications - 1978.
Lines 7-10 taken from Appendix 3.

OPERATING STATISTICS

INVESTMENT and REVENUES (000,000)

1974	AGT	BELL	BC TEL	MTS	MT & T	NB TEL	NFD	SASK TEL	ISLAND TEL	TOTAL
TOTAL REV.	195.6	1440.1	302.9	87.7	81.0	63.6	35.5	76.6	7.6	2290.6
% TOLL	68.6	44.3	53.9	60.5	51.3	56.3	60.4	66.8	48.7	49.9
TOLL REV.	134.2	638.0	163.3	53.1	41.6	35.8	21.4	51.2	3.7	1142.3
INDEX AGT		4.754	1.22	.396	.310	.267	.159	.382	.028	8.789
EXCH. REV.	61.4	802.1	139.6	34.6	39.4	27.8	14.1	25.4	3.9	1148.3
INDEX AGT		13.064	2.274	.564	.642	.453	.230	.414	.064	19.075
COMPETITIVE REVENUE	11.5	73.8	18.1	4.6	4.2	3.2	1.9	4.6	.7	122.6
EXCHANGE	2.2	25.3	4.9	1.1	1.3	.9	.5	1.1	.1	37.4
TOLL	9.3	48.5	13.2	3.5	2.9	2.3	1.4	3.5	.6	85.2
PLANT INV.	881.3	5721.1	1277.6	385.6	317.2	263.2	146.3	326.5	34.7	8903.5
NO. TEL (000)	717	7518	1383	521	379	304	142	391	46	11401
NO. EMPLOYEES	8535	46484	13999	4616	3466	2631	1324	2974	297	84326

OPERATING STATISTICS

INVESTMENT and REVENUES (000,000)

1975	AGT	BELL	BC TEL	MTS	MT & T	NB TEL	NFD	SASK TEL	ISLAND TEL	TOTAL
TOTAL REV.	239.8	1665.9	360.7	104.1	100.4	76.4	43.1	92.1	9.8	2692.3
% TOLL	69.9	45.2	54.0	63.1	52.3	56.5	61.2	68.9		50.8
TOLL REV.	162.6	753	194.8	65.7	52.5	43.2	26.4	63.5	4.7	1366.4
INDEX AGT		4.493	1.162	.392	.313	.258	.158	.379	.029	8.356
EXCH. REV.	77.2	912.9	165.9	38.4	47.9	33.2	16.7	28.6	5.1	1323.9
INDEX AGT		12.14	2.206	.511	.637	.441	.222	.380	.068	18.861
COMPETITIVE REVENUE	15.6	102.4	24.7	6.3	5.8	4.4	2.5	6.3	.9	168.9
EXCHANGE	3.6	40.0	7.7	1.8	2.1	1.5	.7	1.8	.1	59.3
TOLL	12.0	62.4	17.0	4.5	3.7	2.9	1.8	4.5	.8	109.6
PLANT INV.	1101.7	6360.5	1473.7	430.6	372.6	296.7	169.4	388.7	39.3	10633.2
NO. TEL (000)	788	7889	1473	552	392	321	150	422	49	12036
NO. EMPLOYEES	9572	44904	13122	4928	3526	2725	1278	3344	279	83678

OPERATING STATISTICS

INVESTMENT and REVENUES (000,000)

1976	AGT	BELL	BC TEL	MTS	MT & T	NB TEL	NFD	SASK TEL	ISLAND TEL	TOTAL
TOTAL REV.	307.8	1903.9	435.8	129.0	123.1	92.5	51.7	115.6	11.4	3170.8
% TOLL	67.75	45.57	54.11	60.56	52.27	55.47	60.97	67.36	52.33	51.1
TOLL REV.	208.5	867.6	235.8	77.9	64.3	51.3	31.5	77.8	6.0	1620.7
INDEX AGT		4.161	1.131	.374	.308	.246	.151	.373	.029	7.836
EXCH. REV.	99.3	1036.3	200.0	51.1	58.8	41.2	20.2	37.8	5.4	1550.1
INDEX AGT		10.436	2.014	.515	.592	.415	.203	38.1	.054	15.759
COMPETITIVE REVENUE	20.6	140.6	33.2	8.5	7.9	6.0	3.4	8.5	1.0	229.7
EXCHANGE	5.6	62.8	12.1	2.9	3.3	2.3	1.1	2.9	.2	93.2
TOLL	15.0	77.8	21.1	5.6	4.6	3.7	2.3	5.6	.8	136.5
PLANT INV.	1289.1	7108	1727.6	485.7	419.6	341.6	192.2	461.2	44.4	12069.4
NO. TEL (000)	857	8301	1543	578	415	332	159	452	52	12689
NO. EMPLOYEES	9958	48133	13749	4665	3447	2711	1347	3622	288	87920

OPERATING STATISTICS

INVESTMENT and REVENUES (000,000)

1977	AGT	BELL	BC TEL	MTS	MT & T	NB TEL	NFD	SASK TEL	ISLAND TEL	TOTAL
TOTAL REV.	367.8	2133.4	501.6	144.3	143.9	110.0	60.2	135.5	14.2	3610.9
% TOLL	66.07	45.49	53.9	59.68	53.01	54.23	61.08	66.22	51.99	51.0
TOLL REV.	243.0	970.5	270.4	86.1	76.3	59.7	36.8	89.7	7.4	1839.9
INDEX AGT	1.0	3.99	1.1128	.3543	.3140	.2457	.1514	.3691	.030	7.572
EXCH. REV.	124.8	1162.9	231.2	58.2	67.6	50.3	23.4	45.8	6.8	1771.0
INDEX AGT	1.0	9.318	1.8526	.4663	.5417	.4030	.1875	36.70	.054	14.191
COMPETITIVE REVENUE	27.3	183.1	43.7	11.2	10.3	7.9	4.5	11.1	1.3	302.9
EXCHANGE	6.7	76.6	14.8	3.5	4.0	2.8	1.4	3.4	.2	114.3
TOLL	20.6	106.5	28.9	7.7	6.3	5.1	3.1	7.7	1.1	188.6
PLANT INV.	1476	7946.7	1945.6	542.7	455	379.5	212.8	557.1	51.5	13566.9
NO. TEL (000)	930	8620	1601	609	431	343	164	516	55	133269
NO. EMPLOYEES	10357	50350	13274	4703	3448	2671	1349	3820	299	90271

OPERATING STATISTICS

INVESTMENT and REVENUES (000,000)

1978	AGT	BELL	BC TEL	MTS	MT & T	NB TEL	NFD	SASK TEL	ISLAND TEL	TOTAL
TOTAL REV.	443.1	2497.4	551.0	164.7	165.4	123.1	70.5	164.4	16.5	4196.4
% TOLL	65.79	46.15	57.85	60.67	.5462	55.36	61.78	66.09	53.33	52.0
TOLL REV.	291.5	1152.6	318.8	99.9	90.2	68.1	43.6	108.7	8.8	2182.2
INDEX AGT		3.954	1.0937	.3427	.3094	.2336	.1496	.3729	.0302	7.4861
EXCH. REV.	151.6	1344.8	232.2	64.8	75.5	55.0	26.9	55.7	7.7	2014.2
INDEX AGT		8.8707	1.5317	.4274	.4980	.3628	.1774	.3674	.0508	13.2863
COMPETITIVE REVENUE	34.9	233.5	55.7	14.2	13.2	10.1	5.7	14.2	1.8	386.5
EXCHANGE	8.9	98.6	19.0	4.5	5.2	3.7	1.8	4.5	.5	147.9
TOLL	26.0	134.9	36.7	9.7	8.0	6.4	3.9	9.7	1.3	238.6
PLANT INV.	167.9	8685.3	2115.8	619.0	494.2	411.5	234.3	640.5	57.2	14936.8
NO. TEL (000)	1017	8945	1683	640	452	359	175	551	59	13881
NO. EMPLOYEES	10696	53328	13925	4718	3551	2708	1475	3957	293	94651

A.G.T. COMPETITIVE REVENUES (000)

	1973	1974	1975	1976	1977	1978
COMPUTER COMMUNICATION						
EXCHANGE: REMOTE BATCH TERM	30	291	835	1696	2178	2642
TOLL: WDS - MULTICOM	174	267	484	560	740	940
- VOICE COM	212	410	640	930	1232	1802
MSD's	87	90	103	122	91	68
TELEPAK	1081	1290	1979	2524	3403	4049
DATA ROUTE	104	376	823	1300	2452	4119
OTHER	1303	1610	2120	2675	3355	4239
	2961	4043	6149	8111	11273	15217
MESSAGE RECORD						
EXCHANGE: TELETYPE	3	1	4	1	9	32
TOLL: TWX	832	951	964	1083	1206	1391
TELETYPE	473	331	227	130	375	260
	1305	1283	1195	1213	1581	1651
PRIVATE LINE VOICE						
EXCHANGE:	1777	1954	2750	3882	4558	6188
TOLL:	3383	3948	4625	5701	7736	9118
TOTAL EXCHANGE REV.	53400	61400	72200	99300	124800	151600
TOTAL TOLL REV.	109000	134200	167600	208500	243000	291500
TOTAL COMPETITIVE EXCHANGE REV.	1810	2246	3589	5579	6745	8682
TOTAL COMPETITIVE TOLL REV.	7679	9565	11969	15026	20599	26056
TOTAL COMPETITIVE REV.	9489	11811	15558	20605	27344	34738
TOTAL REV	162400	195600	239800	307800	367800	443100
% EXCHANGE	3.39	3.66	4.96	5.62	5.40	5.73
% TOLL	7.04	7.13	7.14	7.21	8.48	8.94
% TOTAL	5.84	6.04	6.49	6.69	7.43	7.84

SOURCE: A.G.T. INCOME STATEMENT

COMPETITIVE REVENUES (000)
TCTS MEMBER COMPANIES

1973	AGT	BELL	BC TEL	MTS	MT & T	NB TEL	NFD	SASK TEL	QUEBEC TEL	TOTAL
COMPUTER COMMUNICATION										
% 76	1.77									
EXCHANGE	30	416	80	15	18	12	6	15	4	596
TOLL	2961	17048	4634	1107	912	728	447	1104	231	29172
% 76	36.51									
TOTAL	2991	17464	4714	1122	930	740	453	1119	235	29768
MESSAGE RECORD										
% 76	107.5									
EXCHANGE	3	2921	563							3487
TOLL	1305	10858	2950	488	402	320	197	486	102	17108
% 76	107.5									
TOTAL	1308	13779	3513	488	402	320	197	486	102	20595
PRIVATE LINE VOICE COMM.										
% 76	45.78									
EXCHANGE	1777	16728	3228	915	1052	738	361	915	245	25959
TOLL	3383	12464	3387	1265	1042	832	511	1262	264	24410
% 76	59.34									
TOTAL	5160	29192	6615	2180	2094	1570	872	2177	509	50369
	9459	60435	14842	3790	3426	2630	1522	3782	846	100732
EXCHANGE	1810	20065	3871	930	1070	750	367	930	249	30042
TOLL	7649	40370	10971	2860	2356	1880	1155	2852	597	70690
% TOLL	80.9	66.8	73.9	75.5	68.8	71.5	75.9	75.4	70.6	70.2

SOURCE: Developed from Appendixes 2, 3 and 5. In accordance with Appendix Notes starting on page 104.

COMPETITIVE REVENUES (000)

1974	AGT	BELL	BC TEL	MTS	MT & T	NB TEL	NFD	SASK TEL	QUEBEC TEL	TOTAL
COMPUTER COMMUNICATION										
% 76	17.16									
EXCHANGE	291	4034	778	150	172	121	59	150	40	5795
TOLL	4043	23277	6327	1512	1246	995	611	1508	315	39834
% 76	53.43									
TOTAL	4334	27311	7105	1662	1418	1116	670	1658	355	45629
MESSAGE RECORD										
% 76	107.5									
EXCHANGE	1	2871	554							3426
TOLL	1283	10674	2900	480	395	315	193	478	100	16818
% 76	105.68									
TOTAL	1284	13545	3454	480	395	315	193	478	100	20244
PRIVATE LINE VOICE COMM.										
% 76	50.33									
EXCHANGE	1954	18391	3549	1006	1157	811	397	1006	270	28541
TOLL	3948	14544	3952	1476	1216	971	596	1472	308	28483
% 76	69.25									
TOTAL	5902	32935	7501	2482	2373	1782	993	2478	578	57024
	11520	73791	18060	4624	4186	3213	1856	4614	1033	122897
EXCHANGE	2246	25296	4881	1156	1329	932	456	1156	310	37762
TOLL	9274	48495	13179	3468	2857	2281	1400	3458	723	85135
% TOLL	80.5	65.7	73.0	75.0	68.3	71.0	75.4	74.9	70.0	69.3

COMPETITIVE REVENUES (000)

1975	AGT	BELL	BC TEL	MTS	MT & T	NB TEL	NFD	SASK TEL	QUEBEC TEL	TOTAL
COMPUTER COMMUNICATION										
% 76	49.23									
EXCHANGE	835	11572	2231	430	494	347	169	430	115	16623
TOLL	6149	35399	9622	2299	1894	1512	929	2293	480	60577
% 76	75.81									
TOTAL	6984	46971	11853	2729	2388	1859	1098	2723	595	77200
MESSAGE RECORD										
% 76	98.43									
EXCHANGE	4	2674	515							3193
TOLL	1195	9941	2701	447	368	293	180	445	93	15663
% 76	98.43									
TOTAL	1199	12615	3216	447	368	293	180	445	93	18856
PRIVATE LINE VOICE COMM.										
% 76	70.84									
EXCHANGE	2750	25885	4995	1416	1628	1141	558	1416	380	40169
TOLL	4625	17038	4630	1730	1425	1137	698	1725	361	33369
% 76	81.13									
TOTAL	7375	42923	9625	3146	3053	2278	1256	3141	741	73538
	15558	102509	24694	6322	5809	4430	2534	6309	1429	169594
EXCHANGE	3589	40131	7741	1846	2122	1488	727	1846	495	59985
TOLL	11969	62378	16953	4476	3687	2942	1807	4463	934	109609
% TOLL	76.9	60.9	68.7	70.8	63.5	66.4	71.3	70.7	65.4	64.6

COMPETITIVE REVENUES (000)

1976	AGT	BELL	BC TEL	MTS	MT & T	NB TEL	NFD	SASK TEL	QUEBEC TEL	TOTAL
COMPUTER COMMUNICATION										
EXCHANGE	1696	23507	4532	873	1004	704	344	873	234	33767
TOLL	8111	46694	12692	3033	2498	1995	1225	3025	633	79906
TOTAL	9807	70201	17224	3906	3502	2699	1569	3898	867	113673
MESSAGE RECORD										
EXCHANGE		2717	524							3241
TOLL	1213	10100	2744	454	374	298	183	452	95	15913
TOTAL	1213	12817	3268	454	374	298	183	452	95	19154
PRIVATE LINE VOICE COMM.										
EXCHANGE	3882	36540	7051	1999	2298	1611	788	1999	536	56704
TOLL	5701	21002	5707	2132	1756	1402	861	2126	445	41132
TOTAL	9583	57542	12758	4131	4054	3013	1649	4125	981	97836
	20603	140560	33250	8491	7930	6010	3401	8475	1943	230663
EXCHANGE	5578	62764	12107	2872	3302	2315	1132	2872	770	93712
TOLL	15025	77796	21143	5619	4628	3695	2269	5603	1173	136951
% TOLL	72.9	55.3	63.6	66.2	58.4	61.5	66.7	66.1	60.4	59.4

COMPETITIVE REVENUES (000)

1977	AGT	BELL	BC TEL	MTS	MT & T	NB TEL	NFD	SASK TEL	QUEBEC TEL	TOTAL
COMPUTER COMMUNICATION										
% 76	128.42									
EXCHANGE	2178	30188	5820	1121	1289	904	442	1121	301	43364
TOLL	11273	64895	17639	4215	3472	2773	1703	4204	880	111054
% 76	138.98									
TOTAL	13451	95083	23459	5336	4761	3677	2145	5325	1181	154418
MESSAGE RECORD										
% 76	130.23									
EXCHANGE	9	3538	682							4229
TOLL	1581	13153	3574	591	487	388	238	589	124	20725
% 76	130.23									
TOTAL	1590	16691	4256	591	487	388	238	589	124	24954
PRIVATE LINE VOICE COMM.										
% 76	117.41									
EXCHANGE	4558	42902	8279	2347	2698	1891	925	2347	629	66576
TOLL	7736	28500	7744	2893	2383	1903	1168	2885	604	55816
% 76	135.70									
TOTAL	12294	71402	16023	5240	5081	3794	2093	5232	1233	122392
	27335	183176	43738	11167	10329	7859	4476	11146	2538	301764
EXCHANGE	6745	76628	14781	3468	3987	2795	1367	3468	930	114169
TOLL	20590	106548	28957	7699	6342	5064	3109	7678	1608	187595
% TOLL	75.3	58.2	66.2	68.9	61.4	64.4	69.5	68.9	63.4	62.2

COMPETITIVE REVENUES (000)

1978	AGT	BELL	BC TEL	MTS	MT & T	NB TEL	NFD	SASK TEL	QUEBEC TEL	TOTAL
COMPUTER COMMUNICATION										
% 76	1.5578									
EXCHANGE	2642	36619	7060	1360	1564	1097	536	1360	364	52602
TOLL	15217	87602	23811	5690	4686	3743	2298	5675	1188	149910
% 76	1.8761									
TOTAL	17859	124221	30871	7050	6250	4840	2834	7035	1552	202512
MESSAGE RECORD										
% 76	1.3611									
EXCHANGE	32	3698	713							4443
TOLL	1651	13747	3735	618	509	406	249	615	129	21659
% 76	1.3611									
TOTAL	1683	17445	4448	618	509	406	249	615	129	26102
PRIVATE LINE VOICE COMM.										
% 76	1.5940									
EXCHANGE	6188	58246	11239	3186	3663	2568	1256	3186	854	90386
TOLL	9118	33590	9128	3410	2808	2242	1377	3400	712	65785
% 76	1.5994									
TOTAL	15306	91836	20367	6596	6471	4810	2633	6586	1566	156171
	34848	233502	55686	14264	13230	10056	5716	14236	3247	384785
EXCHANGE	8862	98563	19012	4546	5227	3665	1792	4546	1218	147431
TOLL	25986	134939	36674	9718	8003	6391	3924	9690	2029	237354
% TOLL	74.6	57.8	65.9	68.1	60.5	63.6	68.7	68.1	62.5	61.7

CNCP MARKET EVALUATION
FOR 1976 (000)

CNCP REVENUE		
	TELEX	70,282
	BROADBAND	5,004
	PRIVATE WIRE	67,034
	TELENET	4,707
	BROADCAST	3,500
		$150,527
MARKET SEGMENTS		
	COMPUTER COMMUNICATIONS	
	PRIVATE WIRE SERVICE	13,600
	BROADBAND EXCHANGE SERVICE	1,900
	TOTAL (12% OF MARKET)	$15,500
	TOTAL MARKET	129,173
	TCTS MEMBER COMPANIES' SHARE	113,673
MESSAGE RECORD		
	PRIVATE WIRE SERVICES	48,100
	TELEX	70,300
	TELENET	4,700
	PUBLIC MESSAGE	17,500
	TOTAL (88% OF MARKET)	$140,600
	TOTAL MARKET	159,754
	TCTS MEMBER COMPANIES' SHARE	19,154
PRIVATE LINE VOICE		
	PRIVATE WIRE SERVICE	5,400
	BROADBAND EXCHANGE SERVICE	3,100
	TOTAL (8% OF MARKET)	$8,500
	TOTAL MARKET	106,336
	TCTS MEMBER COMPANIES' SHARE	97,836

SOURCE: Taken directly from CNCP's Evidence in Chief

TCTS MEMBER COMPANIES*

OPERATING STATISTICS (SUMMARY)

	1973	1974	1975	1976	1977	1978	COMPOUND GROWTH RATE
OPERATING REVENUES TOTAL	6503 1961.1	6287 2290.6	6188 2692.3	6004 3170.8	5908 3610.9	5951 4196.4	16.4
PERCENT TOLL	48.0	49.9	50.8	51.1	51.0	52.0	
TOLL REVENUES	941.9	1142.3	1366.4	1620.7	1839.9	2182.2	18.3
EXCHANGE REVENUES	1019.2	1148.3	1326.9	1550.1	1771.0	2014.2	14.6
COMPETITIVE REVENUES TOTAL	100.4	122.6	168.9	229.7	302.9	386.5	30.9
PERCENT TOLL	70.1	69.5	64.9	59.4	62.3	61.7	
TOLL REVENUES	70.4	85.2	109.6	136.5	188.6	238.6	27.6
EXCHANGE REVENUES	30.0	37.4	59.3	93.2	114.3	147.9	37.6
MONOPOLY REVENUES TOTAL	1890.7	2168.0	2523.4	2941.1	3308.0	3809.9	15.0
PERCENT TOLL	46.1	48.8	49.8	50.5	49.9	51.0	
TOLL REVENUES	871.8	1057.1	1256.8	1484.2	1651.3	1943.6	17.4
EXCHANGE REVENUES	1018.9	1110.9	1267.6	1456.9	1656.7	1866.3	12.9
MISCELLANEOUS STATISTICS PLANT INVESTMENT	8195.1	8903.5	10633.2	12069.4	13566.9	14936.8	12.8
NUMBER TELEPHONES (000)	10682	11401	12036	12689	13269	13881	5.4
NUMBER EMPLOYEES	77528	84326	83678	87920	90271	94651	4.1

*EXCLUDES TELESAT - REVENUE AND INVESTMENT IN MILLIONS OF DOLLARS

SOURCE: Appendix 2

OPERATING STATISTICS - PROVINCIAL TELEPHONE COMPANIES
(A.G.T. - M.T.S. - SASK. TEL.)

	1973	1974	1975	1976	1977	1978	COMPOUND GROWTH RATE
OPERATING REVENUES TOTAL	276.5	359.9	436.0	552.4	647.6	772.2	22.8
PERCENT TOLL	64.2	66.3	66.9	65.9	64.7	64.8	
TOLL REVENUES	177.6	238.5	291.8	364.2	418.8	500.1	23.0
EXCHANGE REVENUES	98.9	121.4	144.2	188.2	228.8	272.1	22.4
COMPETITIVE REVENUES TOTAL	17.1	20.7	28.2	37.6	49.6	63.3	29.9
PERCENT TOLL	78.4	78.7	74.5	69.7	72.6	71.7	
TOLL REVENUES	13.4	16.3	21.0	26.2	36.0	45.4	27.6
EXCHANGE REVENUES	3.7	4.4	7.2	11.4	13.6	17.9	37.1
MONOPOLY REVENUES TOTAL	259.4	339.2	407.8	514.8	598.0	708.9	22.3
PERCENT TOLL	63.3	65.5	66.4	65.7	64.2	64.1	
TOLL REVENUES	164.2	222.2	270.8	338.0	382.8	454.7	22.6
EXCHANGE REVENUES	95.2	117.0	137.0	176.8	215.2	254.2	21.7
MISCELLANEOUS STATISTICS PLANT INVESTMENT	1376.2	1593.4	1921.0	2236.0	2575.8	2938.5	16.4
NUMBER TELEPHONES	1500	1629	1762	1887	2055	2208	8.0
NUMBER EMPLOYEES	14350	16125	17844	18245	18880	19371	6.2
INVESTMENT/TEL.	917	978	1090	1185	1253	1331	7.7

SOURCE: Appendix 2 - Revenue and Investment in Millions of Dollars